NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 64. Vol. X. JUNE, 1897.

NOTES AND COMMENTS.

Change of Address.

IT is now two years and a half since we attempted to make a bold push for success by assuming more direct control of the publishing of this Review. While we have succeeded, at least as much as we anticipated, in increasing our circulation, and in decreasing our financial loss, we have nevertheless found the combination of publisher's with editor's duties too great a tax upon our time and strength. It is therefore with much pleasure that we draw the attention of our readers to the announcement that in future the publication of this Review will be undertaken by Messrs. J. M. Dent and Co.; for we feel that the co-operation of this well-known firm will enable us to put yet more energy into the editorial management of Natural Science. We shall continue to conduct it on the same lines as have been followed from the beginning, with the same editorial staff. Further, we shall hope to receive, in the future as in the past, that kindly help from men of science all over the world, for which our most heartfelt thanks can but poorly repay them. We trust, however, that they, as well as our readers, will recognise that our efforts, if occasionally mistaken, are sincere; and that our aims are such as to demand the cordial help of all who desire the advancement of science and the independence of scientific thought.

It is hoped that the July number, which begins our eleventh Volume, will be specially attractive, by reason of the eminence of the contributors to it, and the illustrations that are being prepared. Orders for Natural Science, and all communications to the Editor, should henceforth be addressed to the care of Messrs. J. M. Dent and Co., 67 St. James's Street, London, S.W.

The Scientific Method in Education.

It is one of the most hopeful signs of the times that, throughout that half of the community which is engaged in teaching the other, a strong desire is being manifested that the rising generation may be

not only instructed but also so trained that all the mental faculties may be cultivated together, and thus enable "men and women to carry on the work of their lives with the greatest possible advantage to themselves and the community." We quote from a little book[1] that has recently come before us, in which are discussed by various experienced teachers the methods of handling those subjects usually included in the curriculum of Secondary Schools.

It is interesting and most encouraging to find that the insistence by the scientific on the paramount importance of practical work has not been without effect on the devotees of the "humanities." Well do we remember in the days of our childhood learning by heart rules and exceptions to rules of gender, syntax, etc.—can we not reel off pages of them even now after years of disuse and application to other things? and, pray, to what purpose? However, *tempora mutantur*, and now we find Mr. Paton, when speaking of Latin, using such language as—"It is a good thing to take first selected Latin sentences, to go through these with the class, giving them sufficient clue to discover the proper meaning, and then making them deduce the rule for themselves. What they have thus found out and formulated for themselves is far more likely to impress itself upon the memory than if they are told, 'This is the rule, here is an example, now apply it to the sentences given.'" The advice is excellent;—we rather wonder how many classical masters and mistresses make any endeavour to work on such lines.

To pass on to those subjects with which we are more nearly concerned. Professor R. W. Stewart, in the article on "Physical Science," while advocating methods with which we agree, introduces the subject of the proper mental attitude of the beginner, and pronounces against the "research attitude," saying "until the scholars have acquired a little knowledge of the subject it is useless to expect them to reason for themselves in the way necessary to follow out even the simplest research." With this we venture to disagree. Pupils cannot begin too young to find out for themselves, and to become aware that by employing their senses they can acquire knowledge and power. An instance will make our point clear: the differences between solids, liquids and gases will probably come early in any elementary course; now if specimens of each are placed before a class and the teacher *points out* the differences, truly the class will learn what he tells them and repeat their lesson more or less correctly. But surely the "research attitude" is possible here, and on every account to be preferred. A teacher who is worth his salt will assuredly by the form of his questions lead the class to notice what differences exist in this particular and that, and finally get the entire class, each pupil for himself, to set down in writing a formulated expression of the facts ascertained, in response to queries, by the united observa-

[1] "Aims and Practice of Teaching." F. S. Spencer, M.A., Cambridge University Press. Price 6s.

tions of the juvenile researchers. True it is useless for the inexpert to observe experiments without knowing what to look for; but we maintain that to *tell* a class what to look for is not much better. A guide is certainly required, but this should be provided by the form in which the question is addressed.

An Appeal to the Teachers.

Professor Stewart strikes a true note when he complains that too often the only scholars who are allowed to take up science are those who are not likely to do well in classics or mathematics; and this affords the opportunity of calling attention to the scant amount of time allotted to science as a subject of general education, and of advising science-teachers to take care that their subject is "not only properly taught under the best possible conditions, but that it is also associated with that amount of literary and mathematical instruction which is most essential to its fullest development."

These, among other ideas, we attempted to impress on the masters of our Public Schools in a recent editorial Note (Natural Science, May 1897, p. 292). But we gladly reiterate this call to arms, for such we fear it must be if the existing preponderance of other subjects and the present one-sided education of our middle and upper classes is ever to be re-adjusted. Some ground, perhaps, has been gained; but there is need for all responsible for the teaching of science to organise their scattered forces, and to sound an advance all along the line. The book before us offers a weapon. If any one would convince an obdurate opponent, let him put before his notice the article by the master-hand of Professor Armstrong, who has contributed a most valuable chapter on the general principles of scientific teaching and the particular way in which chemistry may be dealt with by young students. He has in fact put together a most complete object-lesson couched in language that cannot fail to convince. It was once our privilege to place in the hands of an old man, who was devoted to teaching, but quite ignorant of science, a copy of *Nature* containing Professor Armstrong's well-known elementary syllabus. "How magnificent! had I learned to teach like this, I should have done more good in the world!" was the criticism we received.

The Educational Value of Botany and Physiology.

In the book under review, biological subjects receive their due share of attention. It cannot be denied that botany is an excellent subject for class-teaching. The apparatus required is very simple; the material is cleanly and frequently of considerable beauty; it is possible for every student to have his own specimens and to work them out for and by himself; much of the subject can be learned out of school, and a growing interest added to every walk; the powers of observation, manipulation, drawing, literary expression can all with

proper treatment of the subject be trained and brought towards efficiency. One of the greatest 'bug-bears' of botany is the host of technical terms; the value of these can, however, soon be taught by the use of periphrases first, and the subsequent introduction of the abbreviated expression, which can often be coined by members of a class possessing even but a slight knowledge of Greek and Latin. Interest in the subject can be readily roused and increased by slight digressions (if such a term can be used), dealing with the relation of plants to soils, and insects and other animals. Indeed we are of opinion that in many schools no more stimulating scientific subject can be included than this, though we doubt if as much system can be introduced into the training thus afforded as into physics or chemistry.

It is not often that there is found an advocate pleading for a place for human physiology in a school course, and yet, as the Master of Downing College points out, it is a subject which stands quite alone in its unique power of attracting attention and exciting interest. The opponents of physiology are not few, and the objections urged against it are certainly not entirely groundless. Improperly handled it may lead to an undesirable self-consciousness and loss of the blissful ignorant innocence of childhood—this the abuse of the subject. Properly used there are few if any subjects which so readily arouse the interest; there is an undeniable fascination in knowing even a little of how the fearfully and wonderfully made machine performs its work.

Further, frequent opportunities occur of introducing other subjects, such as the action of levers, elementary facts in hydrostatics, the phenomena of refraction of light and formation of images, the laws of sound—instances might be multiplied indefinitely. We have ourselves more than once conducted courses of lectures in physiology to pupils of from 15 to 17 years of age, and can testify to the remarkable keenness invariably exhibited and to many budding medical students who then for the first time realised that the study of physics and chemistry was well worth the candle if it led to an understanding of the human body.

Boys and girls are but human, and require, like many of their elders, some stimulating and enlivening motive for their work: if a boy can see, or thinks he can see what good his lessons are going to be to him, he will work with zeal; but what he cannot at all easily be made to realise is that mental training in the abstract will create in him habits and powers that will stand him in good stead in after life whatever be his calling. It is the *cui bono* attitude that is the greatest difficulty with most teachers. Boys do *not* desire to be educated, it is enough for them if they be instructed in those subjects and the particular parts of subjects which will 'pay.' Physiology has this great point in its favour: unknown to the pupil, a sufficient and absorbing motive is introduced to help him over the more remote and arduous paths leading to a knowledge of that most engrossing subject—himself.

The Illinois Fresh-water Biological Station.

The sound practical work being done in the United States in fresh-water biology has been alluded to more than once in these pages, and now we have still further evidence of the activity displayed in this direction in the shape of the Biennial Report of the Biological Experiment Station of the Illinois University, and a batch of papers giving some of the results obtained since the establishment of the Station in April, 1894. It may be pointed out in passing that a particular interest attaches to the work of this station, since it is situated in a district, at Havana on the Illinois River, having, on a larger scale to be sure, several features in common with our own 'Broads' country, and the experience gained in America should be carefully considered by all those interested in the proposal to found a fresh-water biological station in East Anglia.

Much of the work so far undertaken at Havana has necessarily been of a preliminary nature, being more especially directed to a determination of the local aquatic fauna. The results obtained, however, even if falling short of the ultimate ideals cherished by the energetic director, Professor S. A. Forbes, are by no means to be despised, and constitute in themselves really valuable contributions to science. Mr. C. A. Hart's paper on the Entomology of the Illinois River and adjacent waters, for example (referred to in Natural Science, vol. viii., p. 228, April, 1896) is an exceedingly useful piece of work in a much neglected field, and those whose appetites have been whetted by a perusal of Professor Miall's delightful book, "The Natural History of Aquatic Insects," will find in Mr. Hart's work much additional information, including keys to the genera of aquatic insect larvæ. Other published papers deal with Protozoa and Rotifera, with oligochæte worms, with parasitic Hymenoptera, and with Ostracoda, while many others are in preparation.

Besides these faunistic studies, an excellent beginning has also been made with the extensive problems of the inter-relations of the different organisms to one another and to the environment. A regular system of collecting at a number of carefully selected sub-stations has been maintained without intermission since the opening of the station. It will give some idea perhaps of the thoroughgoing nature of this work when it is stated that of quantitative plankton collections alone about a thousand have already been taken, while the total number of collections, including insects, exceeds 12,000. When this rich accumulation of material shall have been worked out (and a large part of the work has already been accomplished), we may expect to be put in possession of the finest mass of data concerning the distribution and periodicity of fresh-water organisms ever brought together.

"Pump Plankton."

The only article yet issued on the plankton work of the Illinois Biological Station, is an introductory one by Dr. Kofoid, the station

superintendent, dealing with methods and apparatus. (*Bull. Ill. State Lab. Nat. Hist.*, Vol. v.) Owing to the shallowness of the water in the district investigated, it was found impossible to carry out the collection of plankton for quantitative determination in the usual way, *i.e.*, by vertical hauls of the plankton net. A method of oblique hauls was consequently devised and used for some time, but it appears to have been rather troublesome in practice, and was abandoned in favour of the pumping method. Although collections of plankton organisms have been previously made by pumping water through a net, to the Illinois Station belongs the credit of having first developed this method for use in quantitative work. The advantages claimed for this method over those relying upon the drawing of a net through the water are, mainly, greater accuracy and wider application; for in the first place the exact volume of water passing through the net from the pump can be exactly ascertained, whereas with a net hauled through the water this amount can only be calculated approximately, and secondly, the collection of plankton by means of a pump and hose can be carried on in very shallow water, and even among masses of vegetation. There seems no doubt that the introduction of the pumping method is an important departure in plankton investigation. We can only see one theoretical objection to its use, namely, that the water sucked up by the pump at any particular level does not wholly come from that level but also in part from higher and lower levels. This is probably, however, a point of little practical importance in the majority of cases. Nevertheless we do not think that the pumping method will altogether supplant the earlier practice, for, in addition to its much greater initial cost, the new method demands the attention of two men, one to work the pump and the other to haul in the hose, and further, it could not be easily applied to very deep water owing to the large amount of hose required.

Another important modification introduced into the plankton work at the Havana Station has been the employment of a centrifugal machine for rapidly precipitating the plankton contained in the collections, instead of allowing it to settle of its own accord for twenty-four hours. This innovation not only saves time, it gives more reliable results than heretofore. It was found by experimenting with the same collection of plankton that the settling method gave results differing from one another by as much as 30 per cent. in extreme cases, whereas the action of the "centrifuge" was quite uniform, the plankton always being subjected to the same amount of compression.

We trust that it will not be long before we see similar investigations being carried on in our own country. *The Lancet*, commenting on our recent articles directed to this end, remarks with truth: "The movement is surely a worthy one, and in the interests of science and even national affairs should be supported." Our reinvigorated con-

temporary, *The Zoologist*, also says in reference to our articles: "This investigation has already been commenced in America, Bohemia, Germany, and Russia, and it is quite time England joined that scientific concert." We shall be glad to receive the names (not necessarily for publication) of those who are anxious to support the proposal, so that more active measures may be devised. Communications should be addressed to the Editor, at 67 St. James's Street, S.W.

The Classification of Rodents.

We have received from Mr. Oldfield Thomas a list of "The Genera of Rodents: an attempt to bring up to date the Current Arrangement of the Order" (*Proc. Zool. Soc.* for 1896, pp. 1012–1028). Unpretending though this list be, it deserves more than a simple mention. In the introduction the author states that he has prepared his paper to help such persons as museum-curators and writers either of a text-book or of a faunistic work. And again: "the special object of the list is the proper allocation of the genera in their respective subfamilies, and I have purposely been as conservative as possible with regard to the groups of higher rank, following Alston wherever there has not been very special reason for departing from his arrangement."

We therefore take the paper for what it is intended to be, and limit our remarks on the "groups of higher rank" chiefly to the innovations proposed. And here, frankly, we do not like the "Anomaluri" and "Aplodontiæ" as they stand in the list. Mr. Thomas does not think it at present advisable to consider these groups "as of the same rank as the Sciuromorpha and the others;" but in reality they figure in the list as though they had the same rank. Thus, the gap between them and the Sciuromorpha, etc., contrary to what ought to be the aim of classification, is made wider than in the "current" arrangements; whereas Winge, to whose classification the author objects, has endeavoured to bridge over many of these gaps, in a work whose chief demerit is the fact that it is written in Danish.

With all due respect for the authority of Mr. Thomas, we further think, on the same grounds, that the reasons given for the maintenance of the "Sciuromorpha" and the other "morpha," namely, that they are "time-honoured" and "convenient," are not free from objection. From the beginning, when the "morpha" were not yet time-honoured, the "awkward" families have objected to the Procrustean beds in which they were being forced, and it was to be foreseen that, when the mists by which they were surrounded should be somewhat dispelled, these very stumbling-blocks, together with extinct forms, would furnish the clue for a more natural classification.

To turn to the arrangement of the groups. When we see the Anomaluri at the top of the list and the Lagomorpha at the bottom, we should like to have been told whether, in the author's opinion,

the former are the highest of the Order and the latter the lowest, or *vice versâ*. And are the Aplodontia to be considered as intermediate between the Sciuromorpha and the Myomorpha, as their place in the list seems to imply?

Where unfamiliar names are introduced, on the ground of priority, care has been taken to add the better-known terms in brackets. In matters of nomenclature we agree that there is *dura lex sed lex*; but there is a limit to everything, and *Coendou*, for example, is beyond that limit, since it is merely a gallicised barbarism.

This "Attempt," however, must we repeat, be taken for what it is meant, and here we think that not only the category of persons mentioned by the author will be thankful to him, but the paper will be still more appreciated by all specialists of the Order. Number of genera have not been known hitherto otherwise than by quite insufficient diagnoses, the authors being apparently themselves often uncertain where to place them. In several instances of this kind, amongst the *Muridæ*, the present list is quite a revelation; and so is the assigning to *Typhlomys* its place side by side with *Platacanthomys*.

Only, what Mr. Thomas has given us, is not enough; it must do for the present, but we want something more from him hereafter. We want a Catalogue of Rodentia, a work which can only be done with the help of the material in the British Museum; and the scientific world is entitled to claim it as a right from the authorities of that establishment. Not only is no specialist living so well situated as Mr. Thomas for such an undertaking, but at the same time none is so well qualified for it as himself.

"Guts and Other Charnel-house Stuff."

Dr. Gadow showed us long since that, though despised and spurned by Ruskin, the "more uncomely parts" of our feathered friends are as capable of affording us valuable material for study as is their more pleasing exterior.

Mr. P. Chalmers Mitchell, in a paper in the *Proceedings of the Zoological Society* for January, 1896, attacks the study of intestina convolutions from a different standpoint, but with results very similar to those of Dr. Gadow.

The method of procedure differs entirely from that of Gadow. The intestinal tract is removed from the body-cavity after section of the oesophagus and rectum. The stomach is then placed to the right, ventral surface uppermost, and the loops of the intestine are carefully displayed. Three principal loops are now distinguishable: (1) the duodenal loop, (2) the circular loop, and (3) the rectal loop: and each of these loops possesses some characteristic feature.

The duodenal loop is usually a simple loop containing the pancreas, but it may be expanded into a branching system of folds, or form spirally twisted coils. Its vein is the anterior mesenteric. Branches from this, bridging the intermediate space, supply part of

the posterior region of the gut. In displaying the intestine this bridging vessel has to be cut through, as well as a portion of the mesenteric fold, so as to free the rectal from the duodenal loop, and expose the circular system. These "bridging vessels" are "remarkably constant in the groups in which they occur, and they seem to present a striking instance of a feature which, apparently, could only have arisen from the 'accident' of contiguous position, and is fixed as a normal part of the structure." The relations of the anterior, median and posterior mesenteric, and of the "short-circuitings" or "bridging-vessels" hold an important place in this paper.

The circular loop, in its most typical form, is thrown into a number of corrugated folds or secondary loops, suspended at the circumference of the semi-circular expansion of the mesentery after leaving the duodenum. The median mesenteric vein traverses the centre of this fold and runs out to the remnant of the yolk-sac, situated more or less nearly in the centre of this loop. The size and position of this vestige of the yolk-duct, is one of the features of the circular loop, though second in importance to the nature of its convolutions. It seems that some sort of compensation for the loss of cæca is often made by the elongation of the last secondary loop of this circular system. The numerous figures which illustrate this paper show the wonderfully varied forms which the circular loop may present.

The rectal loop, or last part of the gut, as a rule maintains its primitive straight position, closely attached to the dorsal wall of cœlomic cavity by the posterior part of the primitive straight mesentery. It may, however, take the form of an enormous coil swung at the circumference of a semi-circular expansion of the mesentery. Its vein is the posterior mesenteric.

By his system the author holds that he is able to "display more clearly the relation of the individual cases to each other," and to what he takes to be "the primitive type, and to show the mesentery and the intestinal veins."

Many, on the strength of less work than is here presented, would have foisted upon us a phylogenetic tree, and added another to the legion of systems already extant or defunct. Not so Mr. Mitchell; on the contrary, he tells us that he does not "feel justified in attempting to draw any general conclusions as to the relations of the various divergences from the common type" that he has described. Enough however has been done, he thinks, to show that when more facts have been collected, the method of investigation here adopted may furnish "another clue to that riddle of zoology the classification of birds." In this we heartily concur.

Applying this new method of investigation as far as it will go, the author is led to conclude that, from the point of divergence of type, the Ratitæ deserve their place at the bottom of the avian tree, and that Ciconiiformes, Falconiformes, and Charadriiformes seem to

have departed furthest from the common type. The resemblance which Dr. Gadow claimed for the intestinal convolutions between the Falconiformes and Ciconiiformes, Mr. Mitchell seems unable to support.

The superiority of Mr. Mitchell's system of studying the intestinal convolutions lies in its greater simplicity. It now remains for him to follow the example of Dr. Gadow, and to group into a series of types the various methods of stowing away the intestines, a task by no means easy, and only to be attempted after further research.

THE HOATZIN.

IN his second paper, "a contribution to the anatomy of the Hoatzin, *Opisthocomus cristatus*," which appeared in the *Proceedings of the Zoological Society* for June, 1896, Mr. Mitchell adds a few facts concerning the intestinal convolutions and certain of the muscles of the visceral skeletal apparatus, and of the leg.

The intestinal convolutions have been studied after the fashion just described. As a result it is found that the mid-gut presents a definite divergence from the primitive arrangement. Thereby it is more specialised than in the Galliformes or Struthiones, in which the primitive type is very nearly retained. It seems intermediate between *Pterocles* and the pigeons, but presents many points in common with the cuckoos, thus adding another to the many features common to these latter and *Opisthocomus*.

In spite of the fact that the myology of *Opisthocomus* has been described already by Garrod and Perrin, Mr. Mitchell has succeeded in bringing to light many new points. The most interesting of these deal with the variations of the ambiens muscle, a subject which has already engaged much of the author's attention; indeed, he was the first to point out the existence of the ambiens, in a vestigial condition, in forms in which it had hitherto been supposed to have been lost. This will be best appreciated by those who know the important place held by this muscle as a taxonomic character. *Opisthocomus* furnishes us with an example, so far unique, of a species in which the ambiens has been found in every gradation from complete development to a mere vestige. "Apart from possible systemic value, it is of interest to find variations of so great magnitude in a few specimens of a bird. Professor Weldon has recently shown, after examination of an exceedingly large number of individuals of shore-crabs that very slight deviations may be associated with a larger death-rate. In the case of creatures so difficult to shoot as *Opisthocomus* it may be the case that those actually examined have, from the greater magnitude of their variations, been less able to escape."

THE "INDEX ANIMALIUM."

THE number of species of recent animals already described has been computed by our Zoological Recorders as 386,000; including

fossils we may well put the number at 550,000. The number of names applied to those animals is, however, far greater. Owing to the ignorance or perversity of men, or to the gradual advance of knowledge, some animals are burdened with as many as twenty names, but—unlike "the ways of constructing tribal lays"—only one of them is right. Now, whatever be the principles that guide a systematist in determining the name that should be applied to a known species, it is clear that he must have all the claimant names before him when making his decision; and not only the names that have been applied to the species in question, but names applied to other genera and species, some of which may have received identical names. Consequently, as we have often urged, a complete list of all names that have ever been proposed is an indispensable preliminary to any effective revision of nomenclature. Such a list is the "Index Animalium," now being prepared under the auspices of a Committee of the British Association.

It has already been shown in NATURAL SCIENCE (Jan., 1896) that the average number of names applied to each species mentioned in the British Museum Catalogue of Birds is 5¼. But on a more moderate estimate of three names to each known species in the animal kingdom, this Index will have to contain no less than 1,650,000 references. The mere writing of these is almost a life's work; and to this labour must be added that of searching for scarce literature, of verifying dates—a most important part of the work, of interpreting obscure passages often in strange tongues, and of sorting the slips into alphabetical order under genera. To this gigantic task, Mr. C. Davis Sherborn, an enthusiastic and competent bibliographer, has devoted himself. In the course of some four years he has completed 140,000 references, each on a separate slip and in duplicate. These are arranged under genera as the work goes on, so that they are always available for reference. Any zoologist can see them by applying at the library of the Geological Department of the British Museum (Natural History), and in this way or through correspondence many have already derived important help from Mr. Sherborn's labours.

Descriptions of the methods and progress of the work have recently appeared in the *Proceedings of the Zoological Society* (1896, pp. 610–614) and the *Geological Magazine* (Dec. iv., vol. iii., pp. 557–561, Dec., 1896); but, feeling that zoologists in general are not sufficiently aware of the service being rendered them, the Committee has asked us to draw attention to it. We do so with great pleasure, and we earnestly trust that some practical expression of sympathy may be the outcome. The British Association was able last year to make a grant of £100 towards the work; but this does not go far, and there is no guarantee that a repetition even of this will always be practicable. To make satisfactory progress, at least £200 a year is needed, and the zoologists and palæontologists of the world should surely be able to provide that sum.

THE DUTCH SCIENTIFIC AND MEDICAL CONGRESS.

THE sixth Meeting of the Nederlandsch Natuur en Geneeskundig Congres took place at Delft, on April 22nd, 23rd, and 24th, and afforded two English visitors, who were privileged to be the guests of Prof. Lobry de Bruyn, an opportunity of seeing how well these things are done in Holland, and of carrying away a very pleasant impression of Dutch hospitality. The proceedings opened on Thursday with a reception at the Stads Doelen, and closed on Saturday with a dinner at the same place, from which members and guests adjourned for the further entertainment of tableaux vivants and a social gathering. The "Phœnix," or students' club house, was also generously thrown open for the occasion. The general President was Prof. J. M. Telders, and the five sections were presided over respectively by W. A. van Dorp of Amsterdam, W. Kapteijn of Utrecht, P. P. C. Hoek of Helder, H. Treub of Amsterdam, and K. Martin of Leyden. The sectional meetings were held in the various laboratories and lecture-rooms of the Polytechnic School, in both morning and afternoon. Several of the sections had very attractive programmes; among the most interesting papers in Section II (Biology) may be mentioned one by Prof. Hubrecht on "Primates and Lemurs," and one by M. C. Dekhuijzen, of Leyden, on methods of investigating the micro-organisms in fresh water. The Section for Physics and Chemistry had an able paper by Col. C. F. Geij van Pittius, on various explosives, and one by H. A. van Ijsselstein on an interesting form of telephone. But the paper which formed the last of the series on Saturday was one so brilliant as almost to throw all others into the shade; this was a lecture by Prof. M. W. Beijerinck, on luminous bacteria, illustrated by lantern-slides and a really magnificent series of experiments, which received the applause they deserved. Prof. Beijerinck's work in bacteriology is well-known; he has discovered at least two new species of marine bacteria which cause phosphorescence, and his experiments to show the nature and extent of their luminosity, and the conditions under which they exhibit the phenomenon could hardly be equalled for beauty and interest, and were worthy of a far larger audience than could be accommodated in the lecture-room of the Natuurkundig Laboratorium. In the intervals between meetings, members and visitors were given the opportunity of seeing the beautiful porcelain-manufacture, for which Delft has always been famous, a process of etching on glass for decorative purposes, various exhibits of scientific apparatus and other objects, and last, but not least, many places of historic interest, as, for instance, the staircase where William the Silent met his death. The quaint picturesqueness of the old town, with its waterways, and its delightfully fresh and bracing air will make the Delft Congress a pleasant memory to many of the 1,000 people who gathered to do it honour.

Publication by the U.S. Department of Agriculture.

A note in our April number has caused somewhat of a scare among the numerous European workers who have hitherto esteemed highly the receipt of the valuable publications of the U.S. Department of Agriculture, publications which cover many departments of natural science. From information courteously sent to us by Mr. Charles Dabney, Acting Secretary of the Department, we are glad to learn that matters are not quite so bad as they seemed to be.

The law to which we referred excepts, as we said, copies required "for Official use." Under this saving clause the officers of the Department and of its bureaus are allowed a considerable number of copies of each publication, and the term "official use" has been construed very liberally, so as to include exchanges. "Every person," says Mr. Dabney, "who forwards to the Department of Agriculture any publication of value, or contributes anything to its library, will, so long as the supply holds out, be placed upon a list of exchanges for the bureau to which he contributes. All correspondents who supply information, including scientific men who send their *separata*, may be included among these exchanges at the discretion of the head of the bureau. All others can secure these publications by registering for them and paying the price thereof at the office of the Superintendent of Documents, Union Building, Washington, D.C.

"As a matter of fact, the Department of Agriculture makes, under this construction of the law, a tolerably liberal distribution of its documents. During the fiscal year ending June 30, 1896, it mailed abroad publications aggregating in weight 230,000 ounces, upon which postage amounting to $1150.00 was paid. Five hundred copies of the Experiment Station Record, which is one-tenth of the entire edition, are mailed free to foreign exchanges, while to other individuals it is supplied at $1.00 per annum or ten cents per number."

The only difficulty in the present arrangement is that the Superintendent of Documents will not accept cheques or postage stamps, but must always have money orders. We learn that an effort will be made to remedy this difficulty. Meanwhile the Americans can retort that it is not peculiar to America, since an American who wants a publication of the British Government has to send a money order to the publisher in order to obtain it. A pamphlet which costs an Englishman twopence halfpenny, costs an American in this way 24 cents.

Civilisation in the United States Congress.

We quote the following from the *Daily Chronicle*:—

"The Indians of North America have a terrible reckoning against the white man's civilisation, and it is disheartening to learn from Washington that the bad business still goes on. By a beneficent law passed nine years ago, an Indian woman marrying a white citizen

became a citizen herself, and her offspring were entirely separated from the degrading influences of Reserve life. All this has been changed by a measure which has just been hurried through Congress. The children of mixed marriages are to remain Indians, and thus one of the most effectual means of removing the Indian question from the problems of the State has been destroyed. Another retrograde enactment hands over to mining speculators enormous deposits of gilsonite found in the reserves set apart for the Utes. The Board of the Indian Commissioners earnestly protested that if these mineral lands were to be opened it should be done by selling or leasing the deposits to the highest bidders for the benefit of the Indians, but Congress seemingly went its own way."

THEORETICAL DARWINISM.

WE have the misfortune to find Mr. G. D. Haviland, M.B., F.L.S., a singularly trying author. We have received from him a pamphlet in two parts ("Some Factors in the Evolution of Adaptations": R. H. Porter, London, 1897), in which he discusses in a purely abstract fashion several very interesting problems. He lays down certain definitions and axioms, and then, in a series of propositions, deduces in a most logical fashion some biological results of great importance. Unfortunately, however, biology, the doctrine of life, is not founded on a series of abstract propositions, but on the infinite variety of living nature. Mr. Haviland, at any rate in this pamphlet, does not condescend to observation or to citation of the observations of others. Logical deduction, however cleverly contrived, is of little interest by itself. As a preliminary to observation, as a means of framing provisional hypotheses that may serve as directions in devising experiments, it is an invaluable scientific weapon. But most people who wish to make investigations are able to frame their own preliminary deductions; and we imagine that, in its present form, Mr. Haviland's ingenious logomachy will be of little service. If he wishes to claim the attention of biologists, he should attempt observation on the lines of some of his own propositions. For instance, the third corollary to one of these propositions is that "neither polygamy nor prostitution will influence the proportion of the sexes." Let Mr. Haviland collect and publish information bearing on this, and we shall all read him.

COLOUR VARIATION IN FLOWERS.

So much has been written of late on the question whether variation takes place in a definite direction or indefinitely, and, to the would-be explainer of evolution, the question is in fact so important, that a note by Mr. F. A. Waugh, in the March number of the *Botanical Gazette*, on the definiteness of colour-variation in many flowers, seemed to promise something of interest.

"The centrifugal encroachment of a darker upon a lighter colour in blossoms is," says Mr. Waugh, "one of the commonest lines of

definite variation." It furnishes the dark-eyed varieties of *Primula Chinensis*, and governs the variations in markings of marigold, poppies, pelargoniums, and many others. A striking case is afforded by a cultivated species of *Coreopsis* (*C. tinctoria*). This is a Composite flower, the rays of which are yellow with a small but variable maroon base. In the very numerous varieties the maroon constantly encroaches upon the yellow, until, in extreme forms, it quite supersedes the body-colour. The impression given (though for some reason this was not proved by sections) is that "the brownish pigments were spread first over the upper surface and subsequently increased in depth, first showing through in the thin areas." A similar series is presented by the flowers of a *Freesia* (*F. refracta* var. *alba*). In this case it is the appearance and gradual spread of an orange-yellow over the pure white that is claimed as an instance of definite variation. The colour shows itself first at the base of the upper petals, and extends over their inner surface, then appears on the backs of the petals, following the same definite centrifugal lines as in *Coreopsis tinctoria*. Sections made through petals from various flowers in the series showed that the yellow pigment on its first appearance was confined to a single layer of subepidermal cells, whence it extended through the intermediate cells to the under surface.

The facts are interesting enough, but, after all, they seem to have but little bearing on the question of definite variation, except in so far as they suggest that many supposed cases are the natural outcome of physiological causes. It is not difficult to imagine a reason why colour should spread in this centrifugal manner. It is doubtless in some way connected with nutrition, and as the petals are attached to the floral axis by their bases, a change might be expected to start at, and spread from, the point most nearly connected with the main axis from which the member receives its supply of nourishment.

Boulder Clay, a Marine Deposit.

In 1843 Portlock recorded the occurrence of shells in the Boulder Clay of the N. of Ireland, and stated that it was a marine sedimentary deposit. In 1879–80, S. D. Stewart published a list of no less than sixty-nine species of Mollusca from the Boulder-Clay of the N.E. of Ireland, and remarked on the occurrence of fragile forms, as *Leda pygmæa* and *L. minuta*, with united valves, as indicating that these shells had lived and died in the position in which they were found. Joseph Wright and James Neilson have now systematically recorded the Foraminifera found by them in Ireland and around Glasgow in the Boulder Clay, and thus give additional evidence as to the marine sedimentary nature of this deposit. According to these authors (*Trans. Geol. Soc. Glasgow*, X., 263–279), the Foraminifera found therein are exceedingly abundant in places, are mainly boreal forms, and are as perfectly preserved as are those of a recent sounding. Messrs.

Wright and Neilson's results are of considerable interest, and should be compared with Victor Madsen's lists noticed in NATURAL SCIENCE, May, 1895, p. 355.

An extension of this investigation to supposed glacial deposits of North America has been made by Dr. G. M. Dawson, who contributes some results to the last number of the *Journal of Geology*. Mingled with fossils and rock-fragments that are obviously derived, he finds many tests of Foraminifera which must have lived on the spot where they are now found.

AN OLD ZOOLOGICAL RECORD AND ADDRESS BOOK.

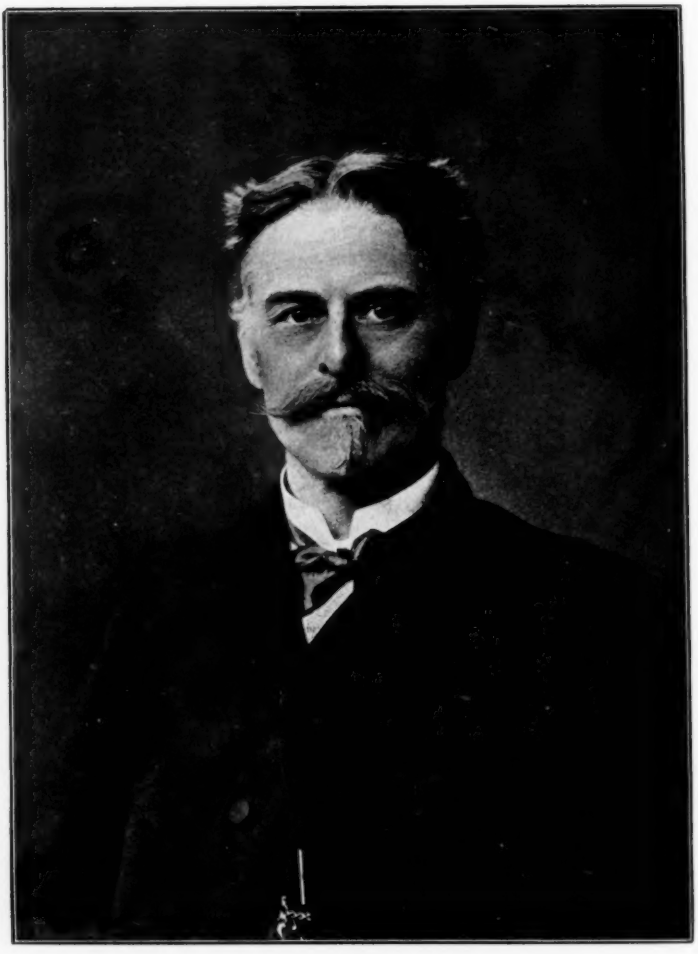
POSSIBLY few are aware that over a century ago there was founded a zoological record, viz., F. A. A. Meyer's *Zoologische Annalen*, which was published at Weimar in 1794, and ran for one year only. Meyer gave an account of zoological works issued up to Easter and up to Michaelmas 1793, an alphabetical list of all living zoologists, an account of all the zoological collections known to him, and a sketch of all the new animals described during the year, in systematic order. It must have been extremely useful to workers at the time, and one is somewhat surprised that it was allowed to drop so soon.

THE FALSIFICATION OF THE RECORD.

THE *Irish Naturalist* has done such good work in the study of the geographical distribution of animals and plants in Ireland that it is entitled to protest, as it is now doing, against the indiscriminate attempts that are occasionally made to introduce foreign species into that island. The record of former changes on the earth's surface, preserved to us through the present distribution of species is most important, and anything that unnecessarily tends to vitiate it should always seem reprehensible to the naturalist, Irish or otherwise.

TO THE HUMANITARIAN LEAGUE.

Mr. Southwell's letter on the alleged golden eagle, and the review of "The New Charter" by an esteemed contributor, are not the only protests against the methods of the Humanitarian League that have come to our letter-box. All naturalists must wish well to the objects of this League, and therefore in sincere kindness we suggest to its members that they should not let their feelings carry them into such inaccuracies and exaggerations of statement as they are too often guilty of. There are in the three kingdoms plenty of trustworthy field-naturalists who would be glad to help the League with a little advice gratis.



EDWARD DRINKER COPE.

Born July 28, 1840.
Died April 12, 1897.

I.

Edward Drinker Cope.

BY the death of Professor Cope of Philadelphia, announced last month, biological science has been deprived of one of the most restless and fertile brains ever devoted to its interests. Continually on the alert, devouring every new zoological paper or memoir with almost feverish excitement, though confining his own personal researches exclusively to the Vertebrata, Cope made many of the boldest and, in some respects, the most successful attempts, which have hitherto been devised, to solve the problems of organic evolution. Though, perhaps, often premature, and sometimes mingled with much error, which a more cautious enquirer would have avoided by waiting for additional evidence, his remarkable speculations—some have even dared to regard them as wild guesses—have had an influence on the progress of modern biological research which it is impossible to estimate. There sometimes proved to be only a small kernel of truth in the new conception as it first appeared; the original statement was often gradually modified in a rapid series of provokingly desultory notes, perhaps mostly evoked by the writings of his fellow-workers, whose interest in the subject he had aroused; but there was always a spark of suggestiveness which opened up some new line of enquiry, and there was an almost never-failing acumen in distinguishing the important from the unimportant features of a case. When others published a plain statement of facts, Cope would often interpose, usually on the spur of the moment, to add a sparkle of philosophy to the contribution; and much of his brilliant generalization appeared in the characteristic reviews in the *American Naturalist*. His influence in personal intercourse, too, has probably not been equalled since the days of Louis Agassiz. To know him in his museum-house in Pine Street, Philadelphia—to see him at work, to hear him discuss the piles of new literature he happened to be reading —was a source of inspiration which could never fade from the memory of any young biologist who had the privilege of thus coming in contact with him. When financial misfortune overtook him some years ago, before he was called to a Chair in the University of Pennsylvania, he cheerfully adapted himself to the new and, to him, strange conditions, not relinguishing his scientific occupations in the

least. To the very end he was absorbed in the fascinating problems which he began to study forty years ago.

To allude to his own special researches, those, namely, in the structure, classification, and evolution of the vertebrated animals, perhaps the most significant feature to note is the importance Cope ascribed to the characters of the skeleton. In view of the researches of Oken, Cuvier, Owen, Huxley, and others, it cannot be said that the study of the skeleton had been neglected before Cope began his work. It is, nevertheless, true that he was the first to emphasise the importance of certain osteological characters in many groups where their significance had been overlooked; and he was more successful in determining the natural affinities of certain forms, even in defining some great groups, than any of his predecessors, who had been misled by mere external resemblances. So long ago as 1865, for example, he arrived at the broad classification of the frogs, which everyone now admits to be truly natural, by a detailed examination of the skeleton in the various genera. A little later, he similarly laid the foundation of the now generally-accepted classification of the lizards; still later, he proposed the only really natural arrangement of the Chelonia, by reference to the characters of the neck-vertebræ. His arrangement of the bony fishes, also, first sketched roughly in 1871, was a great advance on any scheme previously published, owing to the acumen with which he employed the osteological characters of the group. In this work he was immensely aided by the unique collection of skeletons prepared by Professor Josef Hyrtl of Vienna, which he purchased at an early stage in his scientific career.

During the first decade of his original researches, Cope confined his attention almost entirely to the existing Vertebrata. It was only later, when he began exploration, partly on his own account, partly under the auspices of the United States Government, that he made a special study of extinct types. Between 1859 and 1864 he wrote on recent Batrachia and Reptilia; and in the latter year he published his first ichthyological paper, on a blind siluroid. In 1865, he seems to have described a fossil vertebrate for the first time, the Labyrinthodont *Amphibamus grandiceps* from the Coal Measures. In the same and the following year he paid much attention to the existing Cetacea. Then came the first of his long series of papers on extinct reptiles (on the Dinosaurian genus *Lælaps*, 1866). His work on extinct Vertebrata for the United States Geological Survey was not confined merely to the numerous small papers he published, but was also issued in a more handsome form in two illustrated quarto volumes, the first on "The Vertebrata of the Cretaceous Formations of the West" (1875), the second on "The Vertebrata of the Tertiary Formations of the West" (1884). The latter, though an especially bulky tome, is described as "Book I," and was, unfortunately, never followed by the succeeding "Book," which Cope duly prepared but never had published, owing to political changes which led to his exclusion from the public service.

It is impossible to enter into the details of Cope's life-work on the extinct Vertebrata; it must suffice to note a few of the salient points. Of the lowest ancestral Vertebrata, he had practically no examples to study; but he closely followed the descriptions of others, and it is mainly due to his initiative that we now regard the strange Pteraspidæ, Cephalaspidæ, and Asterolepidæ (Ostracodermi or Ostracophori, as Cope termed them), of the Upper Silurian and Devonian rocks, as the armoured extinct allies of the modern lampreys (Marsipobranchii). The suggestion had been made before; but Cope's "wild guess" that *Bothriolepis* and *Pterichthys* might be compared with the modern armoured tunicate, *Chelyosoma*, excited renewed interest and drew closer attention to the subject. As new facts accumulated he gradually veered round to the now generally-accepted view, that these strange armoured creatures were to be placed a little higher in the scale than he at first supposed. Among the lowest fishes Cope was the first to recognise the primitive Palæozoic order of sharks, termed by him Ichthyotomi. This he claimed for some time to be ancestral both to sharks, and to all other fishes; but as soon as *Cladoselache* was described by Dean from the Upper Devonian he at once gave precedence to the latter. He also seems to have been the first to suggest that the double ventral series of spines between the paired fins of certain Lower Devonian Acanthodian sharks (e.g., *Climatius*) are remnants of the two continuous lateral folds in which the paired fins had their origin. His most important generalization concerning the so-called "Ganoids," which of course he did not accept as a definable group, was his clear enunciation of the stages in the evolution of the fins and their primary importance in classification—a result partly anticipated by Huxley and Traquair. Among bony fishes, he began to instil order into the chaos which he found in published writings on the fish-remains from the Chalk; and he described many fine specimens from Kansas. He also added enormously to our knowledge of the Tertiary bony fishes of North America.

Turning to the extinct Amphibia, he made known a great series of Labyrinthodontia (Stegocephala, as he termed them) from the Coal Measures of Ohio and the Permian of Texas. The anomodont reptiles (which he termed Theromorpha or Theromora) also interested him deeply, and he described a great number of forms from the Permian of Texas and other regions. He followed the lead of Owen, and declared these reptiles to be the ancestors of the Mammalia. Many of the remains described, however, were so fragmentary that there is still much uncertainty as to their true nature. Among higher reptiles, Cope paid much attention to dinosaurs, though most of his specimens were very fragmentary, and he only distinguished in a vague way many features which later discoveries by contemporaries revealed clearly. He shares with Leidy, Huxley, and Phillips, the credit of first recognising the true character of the pelvis in the

Iguanodont Dinosauria. His early descriptions of the Pythonomorpha (as he termed the extinct Mosasaurian reptiles of the Chalk) led to most interesting discussions with Owen, and added greatly to our knowledge of these marine lizards.

In reference to the Mammalia, one of Cope's most remarkable generalizations was his so-called Tritubercular Theory, explaining the origin of the cusps in the molar teeth. He believed palæontology proved that even the most complicated molars could be traced back to simple tricuspid or tritubercular teeth. He also extended Kovalevsky's work on the feet of the Ungulata, and proposed the most natural arrangement of this great Order hitherto suggested. He elucidated the evolution of the camels in great detail, from American fossils; he also defined a great number of genera and species of other extinct ungulates.. His most important contribution to the subject, however, was the detailed description of the nearly complete skeleton of a Lower Eocence quadruped, which he named *Phenacodus*, and made the type of a suborder Condylarthra, believed to be ancestral not only to the true Ungulates but also to most other divisions of placental mammals, including man himself. Finally, he defined the primitive suborder of Carnivora, now universally adopted under his name of Creodonta; and he added much to our knowledge of the whole order, especially of the true cats.

One great feature of this systematic work, everywhere conspicuous, is the attempt to define every term, whether specific, generic, of family or higher rank, in a concise diagnosis. Before Cope's time, this method had rarely been applied to extinct animals; even at the present day it does not prevail so widely as it ought to do. Cope, however, made all his definitions as precise as the variously imperfect materials would allow; and he naturally waxed wroth in his reviews of some contemporary literature which contained new names with nothing but an artist's drawing to justify their introduction into scientific terminology.

As to Cope's philosophy, he began to write on the problems of organic evolution so long ago as 1869, and his researches ran curiously parallel with those of his friend, Alpheus Hyatt, who arrived at the same result from a study of the shells of the extinct cephalopod molluscs. He and Hyatt, indeed, founded the Neo-Lamarckian school which has flourished so vigorously of late in America, and begins to find increasing favour in the Old World. Several of his most suggestive essays were collected in a volume entitled "The Origin of the Fittest," published in 1887; and only last year he summarized his latest views in a smaller treatise, "The Primary Factors of Organic Evolution." A critical and detailed account of the latter work, by Mr. F. A. Bather, was published in NATURAL SCIENCE for January last, so that a long exposition is not required here.

Cope believed that all organisms, impelled by some inherent growth-force, which he termed "bathmism," varied in certain definite

directions, and that all modifications ultimately depended on the mechanical conditions of the environment. Palæontology, according to him, proved beyond all doubt that characters thus acquired were inherited. Still further, he promulgated the doctrine, that this development of new characters takes place by an acceleration or retardation in the growth of the parts changed; that, in fact, the adult of an ancestral organism is the exact parallel of an immature stage in its descendant, which only advances or becomes degraded in certain characters during the latest phase of its growth. He was also the first to point out, as the result of these premisses, that the genera of systematists, as commonly understood, are often polyphyletic. According to him, it is the species that are permanent, while genera are but our expression of various grades of organisation through which many species pass. The environment moulds species into genera, and genera into families; and a genus or a family by no means contains forms that are of necessity descended from a common ancestor.

Finally, and not unnaturally, Cope wandered into the domain of mental phenomena, and applied his principles to these. He believed that consciousness preceded the form in which we are accustomed to witness its manifestation, namely organic tissue. His latest definition of life was:—"Energy directed by sensibility, or by a mechanism which has originated under the direction of sensibility."

Cope received the degree of A.M. from the University of Pennsylvania, and Ph.D. from that of Heidelberg; but the honorary distinctions conferred upon him were few compared with those which fall to the lot of most workers of his eminence. He was elected a Corresponding Member of the Zoological Society of London in 1864, a Foreign Correspondent of the Geological Society of London in 1881. He also received the Bigsby Medal of the latter Society in 1879. He was a member of the National Academy of Sciences, and was elected President of the American Association for the Advancement of Science in 1895. His closest connections were always with the University of Pennsylvania and the Philadelphia Academy of Natural Sciences, to which bodies he has left all his valuable scientific collections.

Further interesting facts relative to this remarkable man will be found in the excellent account by Professor H. F. Osborn in *Science* for May 7, while appreciative notices by Dr. Persifor Frazer and Professor J. S. Kingsley are given in the *American Naturalist* for May, accompanied by a very complete series of portraits. Our own plate is from a photograph taken of Professor Cope in 1895, shortly after he had ceased growing a beard.

A. Smith Woodward.

Natural History Museum, London, S.W.

597.5
591.16

II.

Some Effects of Pelagic Spawning-habit on the Life-histories of Teleostean Fishes.[1]

FOR the last few years several naturalists at home and abroad have freely bestowed their time and labour upon the study of the eggs and young stages of teleostean fishes, and, as a result, there are now only one or two species the ontogeny of which is not known. We thus have to hand a long series of memoirs in which the eggs and larvæ of these fishes are figured and minutely described, at all stages in their career, and it is now made evident that our commonest food-fishes go through a remarkable series of anatomical changes before arriving at the adult condition. Intimately connected with this metamorphosis is the change of environment of the young fish during its career; and although at present we know less about this part of the life-history, an increase of our knowledge promises to furnish even more important results, in every way, than the facts of structural change.

This is not the place to discuss how far the structural features are connected with, or determined by, the environmental factors; but we may note, in passing, that teleostean fishes and their ontogeny offer a very advantageous field for the investigation of this general biological problem. A brief survey of what we know concerning the environmental history of two of our common fishes may illustrate this point. In the case of the plaice, the eggs, pelagic and buoyant, are laid in enormous numbers at a varying distance from shore. Tossed about just below the surface, they are carried by currents here and there, eventually inshore, at least in the case of the majority. The larva, some time after hatching and after absorbing its yolk-sac (when it has reached the post-larval stage), migrates downwards to the bottom and then takes up its station close inshore. As growth proceeds, the young fish slowly moves off seawards till the adult stage is reached. In the case of the herring, on the other hand, the eggs (demersal) are laid comparatively near inshore in masses, adhering to any object at the sea-bottom; and the larvæ, on hatching, tarry awhile at the bottom. In a few days, however, they, with an unerring instinct, migrate upwards into the surface-water and move offshore. Later

[1] This paper, in more extended form, was read before Section D of the British Association, September, 1896.

on, they, like the young plaice, are found close inshore, in the littoral region.

It is seen that the life-histories of these two common fishes agree in this particular, that the eggs and larvæ, before arriving at the adult stage, have to pass through many vicissitudes and changes of environment, which in their general features are not accidental, but are determined in their order of succession for each species. These changes we may term the 'ontogenetic migration.'[1] The first and most marked difference of environment is that of the egg itself, and the two general types are illustrated by the plaice and the herring, *i.e.*, the pelagic and demersal. The pelagic egg floats free (rarely in masses) in the open water; the demersal is usually fixed to foreign bodies on the sea-bottom. All the gadoids and pleuronectids appear to have pelagic eggs, whilst the clupeoids vary greatly in type, and the smaller acanthopterous littoral fishes have demersal eggs.

It would be well to inquire into the meaning of these two types of eggs and the remarkable difference of environmental conditions involved; and a careful review of the facts will convince one that the pelagic spawning-habit is the more primitive, and is probably to be interpreted upon phyletic grounds, whereas the demersal has been secondarily acquired in the course of time. A few of the considerations leading to this conclusion may be here given:—

1. The pelagic-spawning fishes are, almost without exception, more prolific: their fecundity may be expressed by as high a figure as 150,000,000 (in the ling), a number beyond all human comprehension.

2. They have more primitive methods of fertilisation and no sexual dimorphism: the eggs and sperms are simply extruded into the water, and there is no 'pairing.'

3. Their methods of reproduction are primitive: there is an extended period of ripening, and after the extrusion of the sexual elements, the demand of the future generation upon the parent comes to an end; whereas in the demersal-spawning types we have, amongst numerous instances, the nest-building habits of the stickleback and its parental devotion to the young, the jealous watching of the lump-sucker, and the careful selection of sites for oviposition by the gobies, features which culminate in the viviparous habit of the blennies.

4. The ontogeny in the demersal types is more protected, and the larvæ are usually hatched at a much later stage than is the case in the pelagic types.

5. There is no conceivable advantage to be obtained by the secondary adoption of a pelagic spawning-habit, but there is in the secondary assumption of a demersal spawning-habit.

These considerations are all correlated, but they form strong

[1] For method of determining exactly this migration, see A.T.M., *Rep. Fish. Board Scotland*, xiv., p. 294, 1896; and *Ann. Mag. Nat. Hist.*, ser. 6, vol. xvi., pp. 285–288, October, 1895.

reasons for maintaining that the pelagic-spawning fishes retain this habit as a survival of a primitive condition, and that this habit is therefore of phyletic significance.

The enormous fecundity of these fishes has not up till now been sufficiently emphasised nor its significance pointed out. Taken as a measure of the amount of mortality amongst the young stages, it points to the fact that this pelagic habit involves a subjection of the young stages to powerful destructive agencies. Prof. G. O. Sars, in his work upon the development of the cod,[1] recognised this fact, and more recently a few observers have given expression to the same ideas; but it is not uncommon to find writers speaking of the great advantages derived by pelagic eggs in that they are removed from the danger of ravenous littoral enemies and even of the trawl. These dangers are brought vividly home to the reader by graphic accounts of countless shoals of haddock following in the wake of spawning herring and feeding on the newly-shed spawn. Whilst granting the truth of these statements, we must recall the fact that the few thousand eggs of each female herring suffice to ensure the preservation of the species, whilst it requires as many millions to perform the same function in some of the gadoids. Some have attempted to explain these facts by an appeal to the appetites of sundry copepods and other crustaceans, to account for a great loss of pelagic eggs; but there seems to be no doubt that these eggs, by their very environment, are subjected to the vicissitudes of the physical world,[2] the destructive powers of which are not limited by the capacity of a stomach, and which cannot be guarded against by translucency, activity, or defensive armour. In changing their spawning-habit from pelagic to demersal, some of the teleostean fishes have removed their eggs and young stages from the action of every intermittent change of wind, tide, and temperature to, in many cases, the direct supervision of the parent. This change has been so successful that, in spite of many enemies hunting the littoral region, the demersal-spawning fishes can hold their own with far less tax upon the organic energies of the parent; in other words, they do not require nearly so high a fecundity.

We may now enquire into the conditions of pelagic habitat, and their effects upon the life-histories of the food-fishes. For this purpose the eggs and early larval stages may be regarded as passive objects so far as the determination of their own destiny is concerned. Some modification of this statement may result from experiments now in progress: the egg, a living object, may react to certain changes of environment in a way which will have to be taken into account, and

[1] Report to Norwegian Home Department, 1864.

[2] *Cf.* C. G. Petersen. 'It is my conviction, however, that the physical conditions here play an exceedingly important part, and this is particularly conspicuous if we try to imagine how all the larval fish which have come out of the eggs are to reach the shore.' *Report Danish Biol. Stat.* 1893, p. 15.

which shows the relations of floating eggs to be markedly different from those of drifting inanimate objects. Broadly speaking, however, it is only when the yolk-sac has become absorbed and the post-larval stage has been entered upon that the little fish is capable of active movement, and can then, to some extent, perform its own migrations.

Taking then a typical case of a certain species, with a pelagic spawning-habit, the eggs will be laid offshore in the surface-water and will be subjected during their development to a pelagic drift, which, in the great majority, will be shorewards. The direction of this drift will be determined by that of the prevalent winds at the particular season, and its duration will depend upon the length of time it takes for the post-larval stage to be reached and the drift-current to be forsaken. In the accompanying diagram (Fig. 1) the point A represents the spawning-area of the species under consideration, and the resultant pelagic drift is in the direction from A to D, at which latter spot the young forms descend to the bottom. It is obvious that this drift can be resolved into a drift A C parallel to the shore and a drift A B at right angles to it. In different areas the comparative magnitude of these two components may vary to any extent; but by the time the adult stage is reached there must be a return to the point A, by a compensating migration of the young forms, or the area would be annually depleted of the species.

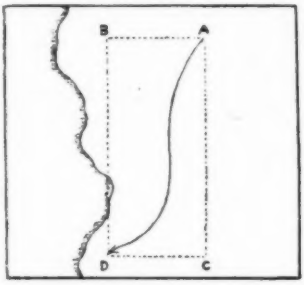
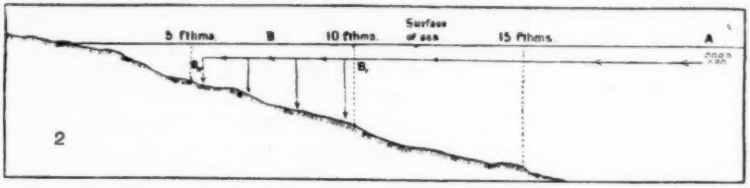


FIG. 1.

In the case of the North Sea, in the east coast of Scotland area, experiments with marked plaice have shown that they slowly migrate northwards parallel to the coast before moving out to the spawning-grounds.[1] Independent observations with drift-bottles tend to show that many of the eggs of the plaice laid off the east coast are drifted southwards in their course.[2] In other words, if in Fig. 1 the top of the diagram be taken as north, A D will represent the course taken by these eggs of the plaice, and the young plaice are found to migrate from D to B along the coast and then outwards to A. There can be little doubt that the two are correlated phenomena. The extent of the drift A C will depend upon the rate of the current, and upon the time during which it acts upon the eggs and larva, but as the drift in this direction can be compensated for, and its lengthening or shortening is apparently not attended by fatal consequences, we may, for the moment, neglect it and consider the drift in the direction A B, assuming in our particular instance that A C=0, or that the eggs are drifted directly inshore.

[1] T. W. Fulton, *Rep. Fish. Board, Scotland*, xi., p. 186, 1893.
[2] T. W. Fulton, *Op. cit.*, xiii., p. 158, 1895.

Let us examine the conditions of pelagic drift along A B by means of two perpendicular sections (Figg. 2 and 3). In Fig 2. are seen the conditions in a shallow-water area, and in Fig. 3, those in an area in which the coast slopes off suddenly into deep-water. The point A is supposed to represent the spawning-area, and the eggs are drifted along A B till at B the young fishes migrate downwards to the bottom, which is, in the ideal case, at a suitable depth for them (in this particular instance, supposed to be from 5 to 10 fathoms). Then it is



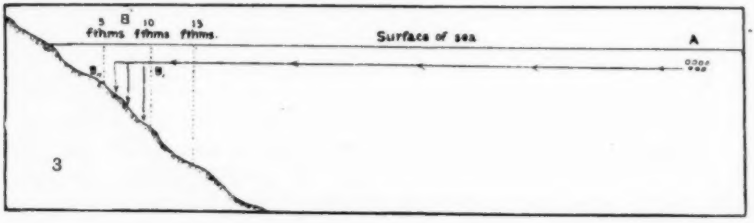


FIG. 2.—PELAGIC DRIFT IN A SHALLOW-WATER AREA.
FIG. 3.—PELAGIC DRIFT IN A DEEP-WATER AREA.

evident that the length of A B must, for the survival of the species, be between the limits A $B_{,}$ and A $B_{,,}$ as all the larvæ, which reach the bottom sooner or later than this, are in an environment to which they are not adapted, and in which they would therefore, in the main, succumb. In Fig. 2, where the conditions of a gradually-shelving shore are shown, the limits $B_{,}$ $B_{,,}$ are wider apart and this may largely explain why slowly-shelving shores and friths are selected by spawning-fish as nurseries for their young in preference to areas with deep water close in shore. The limits of $B_{,}$ $B_{,,}$, and hence of the position of A, are therefore determined, on the one hand, by the bathymetric conditions, and on the other, by the adaptability of the young forms. Suppose the existence of a species in which the young were adapted for living in all the environments which obtain in from 5 to 15 fathoms, then in the area represented by Fig. 2 the species would be able to spawn successfully over a very extended area.

Again, if a species were adapted to a general distribution at various depths, and this adaptability were to be reflected back to its young stages on their assuming a bottom-habitat, then the position of

A (the spawning-area) would only be limited by the necessity for being a certain distance offshore, and beyond this the adults could spawn with impunity in whatever environment they might happen to be. A spawning-migration would then be eliminated, except in the case of individuals living in very close proximity to land. It is probable that the dab is a species largely conforming to this type of spawning.

The first factor in the determination of the spawning-area of a given species is, then, the adaptability or otherwise of the young forms. The second is the nature of the inshore nursery, whether it slopes rapidly or shelves gently.

Let us now consider the other factors determining the length of A B, assuming that B is to some extent fixed, as a mean between $B_{,}$ and $B_{,,}$. Any agents which tend to lengthen A B will then necessitate a spawning-area (A) further out to sea and *vice versâ*.

An egg, or larva, floating inshore remains, as already said, in the pelagic-habitat, till the migration downwards is effected; and this takes place at a definite stage in development. The time taken to reach this stage in ontogeny may be termed the 'pelagic-period,' and it is evident that, for maximum results in the way of successful development, this 'pelagic-period' must correspond exactly with the time taken for an egg or any object to drift from A to B. Suppose that the rate of drift be too rapid, then by the time the egg has reached B the pelagic-period will not have come to an end, and the egg or larva will be washed ashore and perish. Some observers (*e.g.* G. O. Sars, *loc. cit.*) have recorded cases in which myriads of cod's eggs have been thus 'beached,' forming a long glistening line at high-tide-mark. On the other hand, if the rate of drift be too slow, the pelagic period will come to an end prematurely, and the young forms will migrate downwards into deeper water than they are suited for, and, at least in large part, pay the penalty by extermination. There must, therefore, be a close agreement between the pelagic period and the time of drift.

The rate of drift in a given area depends upon the average strength of the prevalent winds; and this on its part depends largely upon the season of the year. Further, as the rate of drift is simply $\frac{AB}{\text{time of drift}}$, the position of the spawning-area must be regulated by the season of the year at which spawning takes place, in such a way that the stronger the winds, the further seawards it must be removed.

Again, the duration of the pelagic period has to be taken into account, for as seen above, it must correspond with that of pelagic drift. The two known factors which determine the length of the pelagic period are temperature and bulk. It has been found that the eggs of fishes, unlike those of higher animals (*e.g.* birds) have not a fixed and definite period of 'incubation,' but that the hatching and development of a young fish can be markedly hastened or retarded by alterations

in temperature of the surrounding medium.[1] Thus, especially when dealing with the lower temperatures, many days or weeks may be added to the length of the period of incubation by lowering the temperature a few degrees. A determination, by direct experiment, of the period of incubation of a given species at various temperatures, and a series of determinations of the mean surface-temperature in any given district for different periods of the year, would thus make it possible to state the incubatory-period for the species in that district. Thus if the spawning-period be late, development will be rapid, and the pelagic-period will be short. It follows from this that the time of drift must be reduced, and, the drift-current being beyond control, the spawning-area (A) must be further inshore. In the case of bulk, it is found as a general rule that the greater the size of the egg the longer is the period of incubation; so that in relation to this factor, the spawning-area (A) will be fixed in position according to the specific size of the egg. Each species will have its spawning-area determined by the size of the egg.

Lastly, we have the factor of specific gravity.[2] Pelagic eggs invariably sink in fresh, and usually do so in brackish water. Hence a fresh-water fish with eggs and larvæ suited to a pelagic existence will have to be katadromous in habit, that is, it must have a spawning migration seawards. The eel and, to a less extent, the flounder may be cases in point. Again, there are relationships of the eggs to their medium of which we know very little. The pelagic faunas of Crustacea and Mollusca are known to be susceptible to climatic conditions, and at different times to be found at the surface, in mid-water, or even deeper. Though the *modus operandi* is not so intelligible, there are facts indicating that, under certain conditions of which we know nothing, the masses of pelagic eggs of fishes are to be found now at the surface, at other times in the mid-water and, again, at the bottom. In each case they are perfectly healthy and developing normally. All that can be said with certainty is that under some conditions the specific gravity of the eggs relative to that of the sea-water is altered, resulting in a sinking or rising. In the Baltic, the eggs of the plaice have been found far below the surface, floating underneath the stratum of brackish water.

The various factors of wind, temperature, and specific gravity have thus been briefly touched upon, and their relationship to the important economic question of the determination of spawning-areas has been shewn. Thus, for the most successful results in the survival of the brood, the spot A in a given area must be selected by the particular species and must be determined by these factors, amongst others :—

[1] H. Dannevig. *Rep. Fish. Board Scotland*, xiii., p. 147; 1895.

[2] *Cf.* J. Hjort. "The distribution of the eggs of pelagic fishes therefore follows the same laws which govern all the Plankton, it is dependent on the amount of saltness and the currents." Studies of the Norwegian Fisheries, 1896.

A. The stronger the drift (dependent upon the prevalent wind),
B. The earlier in point of season the spawning takes place,
C. The greater the bulk of the egg,—
the further offshore must the spawn be deposited.

It follows from this that in a given season of the year in any one district, the larger eggs should be found (spawned) further out from the shore, and that in the case of a species with a wide distribution in time there should also be a wide distribution in place. In the limits of this paper we can only add that these deductions are borne out to a remarkable degree by the work which has been already done upon pelagic eggs.[1] It is, however, interesting to note that by far the largest British pelagic egg, that of the halibut, has not yet been found in British (North Sea) waters, possibly because not sought for far enough out to sea.

When we consider the foregoing, there is little room for wonder that many of the pelagic-spawning fish find it necessary to spawn their eggs by millions, though it is probable that a further study of the spawning-districts will supply definite reasons for the specific variation in fecundity. It is evident that, for the successful development of the young fish, a concatenation of favourable circumstances is necessary, which depends in the main upon such essentially fickle phenomena as wind and temperature. Let the wind blow shorewards with abnormal strength and duration, and untold millions of unhatched cod may perish, or let the temperature for a few weeks during the summer months be abnormally low, and the same fate may overtake hosts of embryonic gurnards. Under such conditions it is only by the selection of suitable spawning-sites, a prolongation of the spawning-time (on the principle of not putting all the eggs in one basket), and other devices, that the pelagic-spawning fishes have held their own.

One might be inclined to inquire, Why do not all these fishes spawn at the same most suitable time and have the same-sized eggs? The answer to this question brings out yet another avenue of destruction for pelagic eggs. Fertilisation of these eggs takes place in a promiscuous manner, the sperms being freely shed in the water, and diffusing themselves in a very rapid manner in all directions. Under this system an enormous number of sperms and of eggs must perish; for though it is a rare thing to meet with unfertilised eggs in the surface-water, yet it must be recollected that, if they do not meet with a sperm, they soon sink to the bottom. It is conceivable, in the case of such gadoids as the cod, which congregate together in "vast heaps," that the mid-water in the whole district simply teems with the sexual elements, and this loss from want of fertilisation is minimised; but in the case of the dab, a diffuse spawner, with no known pairing instinct, there must be enormous losses. But from the very cosmopolitan and ubiquitous character of these sperms there arises another danger—namely, that of cross-fertilisation. Three or four closely-

[1] *See* A.T.M. *Rep. Fish. Board Scotland*, xi., *p.* 250; 1893.

allied species may be found spawning close together in one confined area, so that if fertilisation is a pretty certain process, the chances appear to be nearly even that cross-fertilisation would also take place. Experiments have shown that the pelagic eggs of one species may be readily fertilised with the sperms of another, not necessarily closely related, though the resulting hybrids usually perish at an early stage.[1] The diversity in specific spawning-season and of size of egg may be largely accounted for as a partial safeguard against the evils of cross-fertilisation.

The enumeration of these factors of pelagic spawning points out the lines along which future scientific fishery-work should proceed in the investigation of the life-histories of our food-fishes. Only when we know exactly their spawning-areas and the spawning-seasons can we attempt to close these areas with a maximum of beneficial effect and a minimum of trouble and difficulty to the industries involved. Only when we know the exact spots in the inshore waters most suited for the fry, can we successfully crown the labours of artificial hatching, which attempt to eliminate the natural depleting ravages of wind and temperature, not to mention the fatal effects of non- and cross-fertilisation. Those who deprecate the attempts at artificial propagation now being made would do well to look into this subject of the conditions of pelagic existence. In every important district are required countless meteorological observations of wind and temperature, close investigations of the surface-currents, and a study of the distribution of eggs and fry in the surface- and mid-water.

Reasons have already been given for regarding the pelagic-spawning habit as the more primitive, and this is borne out by the further study of the specific ontogenetic migrations. These may be expressed graphically in cycles (Fig. 4), showing the gradual transition between the pelagic type (plaice) with a full ontogenetic migration and the demersal type of littoral fish with no migration at all, such as the stickleback.

In Fig. 4a there is represented the typical cycle of an ideal ancestor of the fishes. Starting at (P) the pelagic water, we may suppose that this form migrated inwards to the pelagic water inshore (P_i), returning at the breeding-season to its offshore spawning-area, so that the drift inshore of the eggs and larvæ repeated in ontogeny the phyletic history. The same principle held when, from the pelagic inshore water, the littoral region was reached, and later the deeper offshore bottom-areas. In each case, the pelagic eggs formed a starting-point for the ontogenetic migration.

The plaice (Fig. 4b) will be seen to follow this migration almost exactly, its ontogenetic migration being well-marked throughout.

The flounder (Fig. 4c), on the other hand, has complicated matters by itself becoming partially adapted to a fresh-water habitat (F), so that the young forms migrate up the rivers. In this case there

[1] *Cf. Rep. Fish. Board Scotland*, ix., p. 317, 1891; and T. Scott, *op. cit.*, vii., p. 382, 1889.

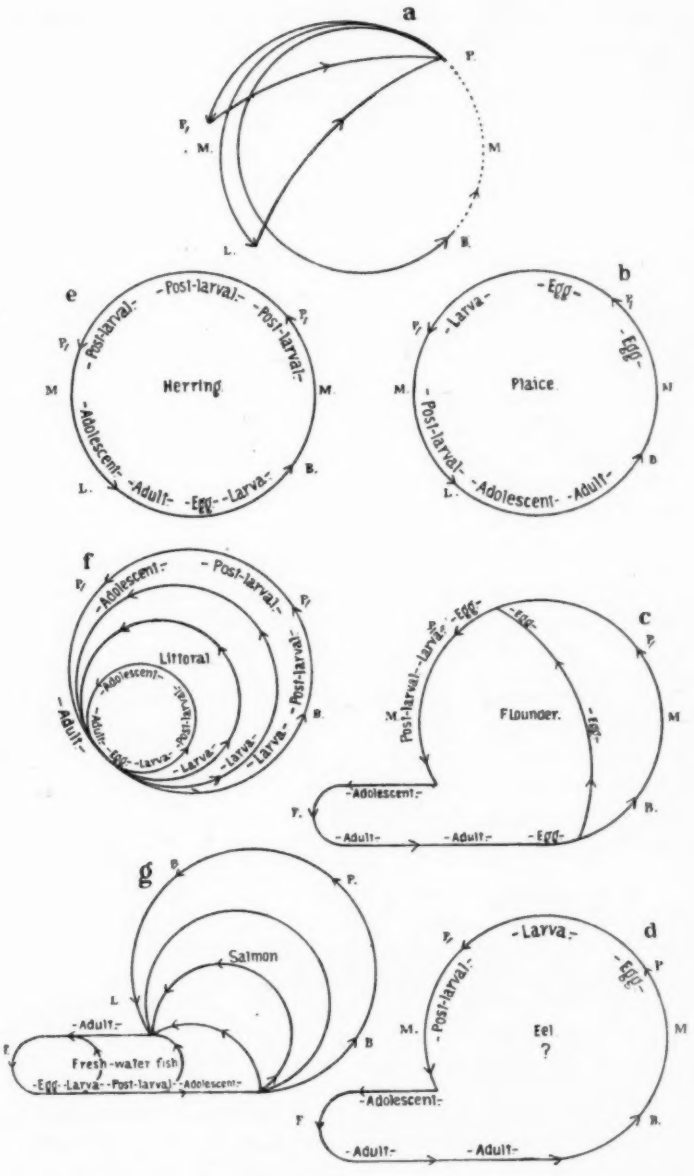


FIG. 4.—DIAGRAMS SHOWING THE ONTOGENY OF MIGRATIONS.

P=pelagic water offshore; P_1=pelagic water inshore; M=midwater region; B=bottom water region; F.=fresh water region; L.=littoral water region.

is a migration sea-wards, but the eggs are small and laid comparatively close inshore.

The next stage in this process is probably seen in the eel (Fig. 4d.), in which the fresh-water habitat has become more pronounced, and, indeed, the normal one for the adult. It is possible that the egg is pelagic, and, after the curious leptocephaline postlarval stage, the adolescent forms (elvers) migrate up the rivers.

In the demersal series, the herring (Fig. 4e) lays its eggs on the sea-floor in moderately deep water, and the larva remains in the same habitat. The postlarval stage, however, moves upward, and passes its time in the pelagic water, eventually coming in to the littoral region. Here the demersal condition is seen in its earliest stage, and from the other littoral fish can be selected a series (Fig. 4f) in which the ontogenetic migration is gradually given up, till, in such as the viviparous blenny and the stickleback, the young forms immediately assume the habits and habitat of the adult.

Certain of these littoral fish have migrated to the fresh-water—*e.g.*, salmon (Fig. 4g),—and these, having in their young stages no adaptations to pelagic life (as in the case of the eel) to contend with, the eggs are laid far up the rivers, secure from the many dangers of the teeming littoral region, though the young salmon, in obedience to ontogenetic exigencies, come down the rivers and complete a migration in the sea. The extent of this is not quite known, but salmon have been caught in the pelagic water far out at sea, so that it is possible that the cycle is fairly well repeated. In the case of the freshwater fish, this cycle is finally given up.

The katadromous type is essentially that of a pelagic-spawning fish with secondary freshwater leanings, and the anadromous that of a demersal-spawning fish with the same proclivities.

It is instructive to note that the ontogenetic migration is eliminated by a process of shifting environmental necessities to a later stage of development. In the herring the sojourn in pelagic waters devolves on the post-larval form, and in the salmon it is further relegated to the adolescent. A stage further back eliminates the migration from the life-cycle altogether. In one case, the angler (*Lophius piscatorius*), there are good grounds for believing that an inshore pelagic spawning-habit has been acquired. The eggs float about in huge masses, and their structure and that of the larvæ is distinctly of the demersal type. The fate of the larvæ on hatching is unknown.

It must not be supposed that, by these types being placed in gradation, there is necessarily any genetic connexion implied between the adults. In this, as in other groups of animals, the closest allies exhibit remarkable differences in their ontogeny, and the gradual transition in ontogenetic processes may quite well be worked out from the life-histories of a series of widely divergent species.

University of St. Andrews, N.B. ARTHUR T. MASTERMAN.

575.
599.9

III.

Human Evolution.

V.—According to Nietzsche.

THOUGH Mr. Wells thinks it proper "to put a flat denial to Mr. Coste's flat assertion," he himself, in a most careless manner, introduces into the discussion new and false assertions, which require even a more emphatic flat denial.

Mr. Wells would make the readers of Natural Science believe that Nietzsche's Gospel is "blackguardism" (or at least the glorification of blackguardism), whereas it is quite the reverse. There is no philosopher more opposed than Nietzsche to everything that is injurious to the human race, and that has a deteriorating influence, while to the anarchism which advocates unlimited liberty for bad men —the prerequisite to blackguardism,—he is, if possible, more opposed than to anything else. He accordingly favours *master-morality* (aristocratic morality), under which the advancement of society takes place, in opposition to *slave-morality* (democratic morality), under which society tends to deteriorate. In every well-regulated and progressive society there must necessarily be a system of ranks and classes corresponding approximately to the merit of individuals and families. The best men should rule and the inferior should obey, if things are to go on well; and when inferior men will not obey reasonable rules, they should be coerced. It is, however, entirely false, and in accordance with the methods of *slave-morality*, to charge Nietzsche with the glorification of blackguardism because he sees clearly that the appropriate coercion of inferior individuals by their superiors is often necessary in order to secure and maintain the highest excellence of society.

Mr. Wells, like many others who assume the functions of moral teachers, does not seem to have any adequate notion of the nature of true morality. The following remarks of Nietzsche apply alike to Mr. Wells's sociology and to his ideal:—"My objection against all the sociology of England and France is that it only knows *decaying types* of society by experience, and quite innocently takes its own instincts of decay as the standard for sociological valuations. *Deteriorating* life, the decline of all organising power (*i.e.*, separating, gap-making, subordinating, and superordinating power) formulates itself as the *ideal* in the sociology of the present day."

Nietzsche makes a further remark in the same book ("Twilight

of the Idols"), which people in this country would do well to ponder. He says that "morality is not yet a problem for the Englishman." It is almost universally taken for granted that measures which make any class of persons happy and comfortable are necessarily good; whereas the facts are almost always overlooked by English moralists that happiness and comfort may in many cases be unmerited, and that measures which result in unmerited advantages to a certain class bring about indirectly undeserved disadvantages elsewhere, and may be prejudicial to society as a whole. Nietzsche saw clearly that the popular notions of morality (which have hitherto also been supported by academic influence) were quite superficial, and exercised an injurious effect. He therefore devoted himself to the great task of effecting a transvaluation, or rather a counter-valuation, of moral values, which involved, in fact, as the title of his unfinished work indicated, a re-appraisement of all the estimates of worth.

It is not enough, however, for the philosopher and the scientist to discover that a system is wrong; their task is not completed until they have explained how the wrong system came into existence and maintained itself. This task Nietzsche has fully accomplished, and has thereby, as it were, put the copestone on the Darwinian edifice, by explaining the evolution of morality—a problem which remained unsolved until Nietzsche's *Genealogy of Morals* appeared. Though he speaks somewhat slightingly of Darwin, his philosophy can, nevertheless, be best understood from the Darwinian point of view—indeed it forms the last and most important chapter of the Darwinian system. The most important distinction among animals is their fitness or unfitness for the conditions of existence, in fact, their superiority or inferiority. It is the same among human beings. As among the animals, however, we see that certain inferior creatures have adopted devices which enable them to maintain themselves (*e.g.*, the serpent by means of its venom, the skunk by means of its stench, the porcupine by means of its quills, other creatures by means of mimicry and suitable coloration), so among human beings the inferior slave-morality has been successfully promulgated under a series of favourable conditions during the past two thousand years, in the interest of the inferior class of human beings, and has partially displaced the older master-morality in those nations which are "in the foremost files of time," and in which, consequently, abnormal social evolution has the best opportunity of developing without producing immediately fatal results. It is somewhat on these lines that Nietzsche explains the origin of the modern notions of morality. It seems to me, therefore, considering the importance of these ideas, that no one is properly qualified to write on morals, or even on human evolution who is unacquainted with Nietzsche's writings.

THOMAS COMMON.

9 Caird Drive, Partick Hill, Glasgow.

509.
010.

IV.

The Genealogy of the Sciences as the Basis of their Bibliography.

HUMANITY, that "Great Man," possesses a knowledge so vast, that in our days even a "God" could scarcely compass it. No one can see and comprehend all that has been made clear and comprehensible. For man cannot become master of all sciences, nor, if there were but one, could he master it. We do not suspect the quantity of work, the wealth of knowledge, represented by our scientific periodicals; and at every moment, while engaged in our researches, we deceive ourselves. No encyclopædia can contain everything. Special dictionaries and treatises may serve as guides to lead us to the original sources. But what devious paths we have to follow before we know what to read to find out about any given subject! And yet we only arrive at it by searching and searching, often without success.

Bibliographies are far from rendering us the services they might. Besides, it is only of late that we have occupied ourselves seriously with scientific bibliography, and what has been done up to the present is merely preparatory. Thus, for example, the "Catalogue of Scientific Papers" of the Royal Society of London can only be considered as a first attempt, in which English, French, and German publications alone have been seriously dealt with, whilst other languages, *e. g.* Russian, have been omitted altogether, or put in here and there. Nevertheless it forms a list of works under authors, very useful in certain cases, but not for those who seek the literature relating to the subject of their study.

Despairing of achieving single-handed a larger undertaking, the English invited every nation to take part in such a work. An International Bibliographical Congress assembled in July 1896, under the auspices of the Royal Society at London. According to the newspapers, the Congress dined well, listened to fine speeches, and then, before separating, certain rules were made, regulating in some way the workers in other countries. It was unanimously resolved that it was desirable to finish the "Catalogue of Scientific Papers," so as to have as complete a list as possible of the scientific literature of the century. It was also resolved that it would be well

to classify the material. Classify—yes—but how classify? Here doubtless there were as many opinions as there were men who had considered the question. They discussed .... and they postponed the discussion to a later date; for one must further discuss and further reflect, and again reflect, and discuss and re-discuss, for this is a question of principle.

The question of classification of scientific papers is a difficult one; it is a question which each can decide in a purely conventional manner, but which perhaps will never be decided rationally and in a really scientific way.

The decimal system[1] of classification is only a method, a *notation*, not a classification strictly speaking. One can apply such a notation to any classification. But the classification of subjects, and of sciences and their subdivisions, ought to be quite independent of any preconceived system. The decimal classification, already in use for science, is based on a purely conventional system which may satisfy a librarian, but should not satisfy a man of science. Therefore the London Congress rejected both the good (of the notation) and the bad (of the classification), and called for a further pause before classifying.

In order to understand the difficulty better let us take an example:

KNUDSEN, Martin. De l' influence du plankton sur les quantités d'oxygène et d'acide carbonique dissous dans l'eau de mer. *Comptes Rendus*, CXXIII., p. 1088. 1896.

How shall we classify this? Is it zoology, botany, or physiology? No, it is rather chemistry, or perhaps physico-chemistry? It is certain that the work belongs to science, thus the first cipher of the decimal classification is obtained; but the second cipher is still doubtful. Having plenty of time, we write to Copenhagen to ask the author. He replies "Oceanography." Oceanography! that is not included in the decimal classification. Never mind, let us admit it as a new subject. But oceanography is "Physical Geography," and Physical Geography is Geography, and thus our first cipher for classification becomes inexact. The work falls outside the domain of science, into the same great division as history. I refer here to the classification as emended by the Brussels Institute, and not to the American system in which Physical Geography is comprised under Geology, a subject with which this paper of Knudsen's has nothing in common. But any geographer of the modern school will tell you that geography forms part of the domain of science, that oceanography is a distinct science, a portion of Physical Geography, which is nowadays divided into mathematical geography, morphology of the terrestrial surface, oceanography, climatology, etc., etc. Now, to classify this work in its proper place so as to be able to find it again at need, so that its catalogue-slip may be of use to the original

[1] Mr. Dewey's system was described in NATURAL SCIENCE for July 1896, vol. ix., pp. 43-52

investigator, demands an acquaintance with the most modern tendencies of oceanography; and this can only be expected of an oceanographer. What is true of oceanography is equally true of other sciences. All scientific men recognise this, and this is why the Royal Society Committee preferred to wait and reflect, before setting to work. The London Congress did well in refusing to adopt any system.

The decimal notation then does not solve the question. Even if one admits this notation for the classification of scientific papers, a base of operations is necessary, *i.e.* a classification of the sciences. And one cannot take any classification; a purely conventional one will not suffice, it must be a natural one, *i.e.* simple and corresponding to reality: a philosophical classification.

It is not possible to trace in a few words the history of the classification of the sciences. I will not even describe the classifications of Ampère, A. Comte, Herbert Spencer, Raoul de la Grasserie, and many others,—because that would have nothing in common with the end in view. On the other hand I have no intention of formulating a new classification in all its details. I desire simply to explain the principles of a classification based on the history of the natural development of science, a classification which must be drawn up by competent specialists, and which would supply, without doubt, the needs not only of a bibliography of science, but many other needs as well. The subject is too vast and difficult for me to discuss adequately; I content myself with setting forth various considerations merely to fix our ideas.

The universal division of science is into pure and applied; then, setting aside applied sciences, we are wont to divide the pure sciences into abstract and concrete. For the rest, classifiers merely enumerate the chief "abstract" sciences without defining them. Thus it is left to each of us, with his own peculiar prejudices, to decide what is meant by mathematics, astronomy, physics, and so forth. Helmholtz, in dividing science into "Naturwissenschaften" and "Geisterwissenschaften," was equally conventional. Equally with those who speak of concrete and abstract sciences, he regarded sciences as definite and stable units, believing it possible to define a science. But what do we understand by the Natural Sciences? For Delbœuf, Geometry is a natural science. And I, who had the good fortune to follow his lectures on the philosophy of the sciences, was convinced by his arguments, and so am perfectly prepared to admit that geometry comes within the realm of Natural Science. Nevertheless only few naturalists, I think, will accept such a heresy. We should, then, have to discuss what was meant by natural sciences,—and it would be just the same with any conventional term.

To take an example. Since sciences are divided into concrete and abstract, let us ask if any science, say chemistry, is an abstract science? If yes—what do we understand by chemistry? All the

assemblage of chemical sciences? Certainly not! In chemistry some portions are purely abstract, but others depend on observation pure and simple, on experiment, application, and so on. By the side of purely mathematical sections are others of speculative philosophy, hardly to be considered science at all, and yet finding place in that whole called chemistry. And it is really a whole which we cannot disintegrate merely to preserve the abstract part of it for abstract science and so maintain the prevalent convention.

It is needless to labour the point. A subdivision of pure science into concrete and abstract is inapplicable, because, however interesting, it has nothing in common with the actual facts of the case.

It is the same with pure and applied science. Pure sciences have developed and produced applied sciences; thus chemistry has produced analytical chemistry and metallurgy; or they may receive direct application in some other science (*e.g.* biological chemistry), or in some art (*e.g.* agricultural chemistry). And chemistry itself was originally an applied science; for the chemistry of the Egyptians was but a trade, while alchemy at first pursued a purely practical end. Medicine is admittedly an applied science. Anthropology on the contrary, although a daughter of medicine, is a pure science. It is medicine also that has given rise to embryology, physiology, human anatomy, and even comparative anatomy, and many other pure sciences. Why, then, separate all these sciences from the mother science? Because it was and is still, an applied science? No! the sciences are bound together by ties of origin, by ties of relationship, —they are children one of another.

The supposed divisions ought to give place to a more natural classification, denoting, by generic terms, both the various families of sciences, and the groups of minor sciences into which they have split up.

Before developing this idea further, we must ask—what is philosophy and what is science? An answer by definitions is of little value. We simply ask if it is possible to draw a line of demarcation between science and the philosophy of science. I think not. It seems to me that any branch of speculation, at a given moment, is capable of scientific verification; and that any science, originally a speculation, only passed by degrees into the region of the positive; that in fact the sciences sprang from philosophy.

On the other hand every science contains a set of observations centreing round a subject, or pursuing a definite end; they all tend towards perfect knowledge and the comprehension of some enigma. But as one never stops at facts, but rather seeks to explain them and to unveil the mystery, so the sciences as they develop lead us back to philosophy. Considered generally, science forms a means of investigation of nature and natural phenomena, a sort of analysis, all serving to form a basis for philosophic speculation.

But many sciences, aiming too high at first, have had to create auxiliary sciences to furnish them with the necessary materials. Thus geology has created palæontology, and there is in the history of geology a long period during which its votaries were absorbed in the study and classification of fossil organisms; and it was only when these palæontological researches were sufficiently advanced that stratigraphy could re-assert its importance. Finally, in our own days, we have been able to attack with success other problems more directly geological, such as the origin of mountains, *i.e.* dynamics of the earth-crust. The questions treated of to-day are old, they were discussed before geology was a science; and it is only because we philosophised over these questions of a general nature that we were led to record observations, add comments and so, as it were, to build up a science. The needs of geology have likewise created petrology, which in turn has sought assistance from optics, and as that does not suffice, we now see it seeking assistance from chemistry. Shortly we shall hear of synthetic petrology. But this science will take further time to develop properly, because chemistry cannot furnish all that the synthesis of rocks requires.

Thus it is that a science, having become positive, serves another science. Mathematics is an example. Physics another, which at the present time, being of current application in chemical, physiological and other investigations, renders services both by its methods of investigation and by its laws and other acquired influences.

But on the other hand many well-defined sciences, becoming relatively far advanced in their development, fuse, making place for higher investigations where philosophy already impinges on science. Physico-chemistry, which in these latter days has developed in Germany to a considerable extent, which has already numerous methods of investigation, and which is sufficiently well-characterised as a distinct science, is a good example. And thus we see sciences, coming from one stock, dividing up in the course of development, and then fusing again to pursue ideas still greater than before, to synthetise the knowledge acquired in some more general law, and in this way, by the intermediary of purely scientific investigation, one is led to the philosophy of one or the other great branches of human knowledge. Thus, close bonds unite positive philosophy to scientific investigation, and it would be very difficult to draw a clear line of demarcation between science and philosophy.

All things meet, but all are not confused. Order exists; let us look for it. Let us first see the historical beginning of a science. Origins are vague. One can always push the origin of a science back as far as one will; but in reality the science has a history only from the time when it is individualised, the day it ceases to be a part of an assemblage of subjects till then confounded. Generally its birth is due to some great thinker, who has specialised in the branch. Such an one, by inventing methods of experiment, or by co-ordinating his

observations, has individualised the science, characterised it, and given it free development. The history of oceanography is an example.

Sniadecki in his remarkable work on the theory of dissolution (1808), said that "sciences are born or become perfect by the discovery of their origins, *i.e.* of some observations embracing a whole group of natural phenomena." And this is true, because if certain sciences have had their founder, others have been called to life by some special discovery, made in some earlier science. A simple observation, well made, may be the germ of numerous discoveries connected with a field of study absolutely unexplored. It may lead to the explanation of phenomena hitherto inaccessible. Bacteriology is a case in point.

Thus then, although their origins are vague, sciences are born, and each has a date of birth; and if all sciences are not founded in the same manner, if there are no general laws governing their mode of origin as well as their development, we are yet able to affirm of all that they never figure in history except after one more or less definite date which can be determined. There are young sciences and old sciences; some are still in embryo (still incorporate with the mother science and developing through her); others have died, but their ruins still serve and will serve always. Sciences, then, are born. And this fact alone gives to each a definite relationship, which may be discovered by the study of its history.

A general and philosophical history of sciences, such as is yet unwritten, would therefore be of the highest utility. Houzeau, in one of his admirable addresses to the Academy of Belgium, has shown that the history of science reveals to us a regular evolution of the human mind. For sciences have evolved like everything else. But more than that. Sciences live; live in humanity just as languages do, or as beings live in nature. The sciences, in the same way as languages, have a genealogical tree. They also are differentiated. The history of the development of science is like that of life, and results in a tree with branches and twigs, of which each twig represents one science. The branches are the mother sciences. The historian of science should begin his work by the study of this tree; and only when it has been traced and explained thoroughly, shall we be able to say we have a history of science.

Order therefore exists—natural order. Natural order is the genealogical tree.[1] Classification therefore must be preceded by a

[1] In his introduction to the Encyclopædia (1781) d'Alembert after having characterised the different sciences, adds "Après le détail où nous sommes entrés sur les différentes parties de nos connaissances, et sur les caractères qui les distinguent, il ne nous reste plus qu' à former un *arbre généalogique ou encyclopédique qui les rassemble sous un même point de vue, et qui serve à marquer leur origine et les liaisons qu' elles ont entre elles.* . . . . . Quoique l' histoire philosophique que nous venons de donner de l' origine de nos idées, soit fort utile pour faciliter un pareil travail, il ne faut pas croire que l' Arbre encyclopédique doive ni puisse même être servilement assujetti à

history; for no classification can be rational unless it is founded on that genealogical tree which the history of science ought to furnish. The progress of science dates only from the middle of last century. It was then only that the knowledge of mathematicians and philosophers became grouped in distinct sciences. The history of science then is recent, because, if need be, we are able to begin with the encyclopædists. And from our point of view, the more modern part of this history interests us the most.

A classification to be useful to a bibliographer should be complete. The natural classification that we demand from history should go further, in the dismemberment of subjects of study, than do the sciences themselves. And it is modern history which tells us how each science is subdivided into sections, embracing each subject of particular study. The history of each science considered separately can go into great detail; it can give numerous data, and as the annals of the sciences are very precise, this history can give a classification down to the minutest details desirable. Thus then each science may be represented by a bundle of branching twigs, upon which we can group with certainty the material to be classified. And in this way we can collect everything that ought to be collected, and classify it, without there being any particular difficulty in avoiding confusion.

But all is not to do, for that which is done persists. Imperishable monuments have been raised to science. Houzeau and Lancaster's Bibliography of Astronomy is one of them. It is to be noted that this Bibliography is based on history; this is more than a series of biographies, it is a history full of observation, a model.

Others than Houzeau have written on similar lines. Each science perhaps has its historians.[1] The Germans and the English have written more than one history of the mathematics, of physics, of chemistry, and other sciences. It is not for us to criticise them; but one may remark that, though precious, they are of no use for our pur-

cette histoire. Le système général des sciences et des arts est une éspèce de labyrinthe, de chemin tortueux, où l' esprit s' engage sans trop connaître la route qu' il doit tenir. . . . . On pourrait former l' arbre de nos connaissances en les divisant, soit en naturelles et en révélées, soit en utiles et agréables, soit en speculatives et pratiques. . . . . Nous avons choisi une division qui nous a paru satisfaire tant à la fois le plus qu' il est possible à l' ordre encyclopédique de nos connaissances et à leur ordre généalogique. Nous devons cette division à un auteur célèbre (Bacon) . . . . nous avons pourtant cru y devoir faire quelques changements." Further on we read: "Ces trois facultés (mémoire, raison, imagination) forment d' abord les trois divisions générales de notre système et les trois objets généraux des connaissances humaines, l'Histoire qui se rapporte à la mémoire; la Philosophie qui est le fruit de la raison, et les Beaux Arts que l'imagination fait naître." That is how d'Alembert was brought to put the history of minerals and plants by the side of civil history, and to unite metaphysics with mathematics. But his errors concern us little; he did the best for his time. These extracts have not been made to criticise him, but to render him his due. The idea of a classification of sciences based on such a genealogical tree was clearly formulated in 1781.

[1] See Jahresberichte der Geschichtswissenschaft,—§70 of the last few volumes especially.

pose. A good history of chemistry, for example, has yet to be written, and the work done on the lines here suggested would be more interesting. The history of geology also might contain interesting pages, but this history does not yet exist.

We may be told that there are many sciences, and that if we must wait for the history of each before pushing onwards, we shall always remain in one spot, and nothing will ever be done. Yes and no. The Germans are capable of furnishing us this kind of work in a short time, and it would be done conscientiously. The Munich Academy has already published a general history of science. We cannot use it; but never mind, the example is there. And examples of this kind abound. The Germans know how to combine to work on a given plan. Why then not ask of them a general history of sciences, prepared by the most competent men? The thing is possible and its realisation does not offer any special difficulty; sooner or later therefore it will be realised. With such a history of the sciences we should have a sure guide for classification.

There is, however, a real difficulty before us. What do we mean by a science? For example, is statistics a science? Evidently not. It is only a method which can be applied in many sciences. Yet certain sciences can equally well be applied as methods of verification. There lies one difficulty.

Let us take another example. Is graphology a science? Its founder considered it as such. It has a certain aim, the subject is well defined; but nevertheless we cannot admit that it is really a science, because to make scientific observations you must have a method; and graphological observations are made without method, they are conventional. Graphology is an art (founded on observation) as alchemy was an art (founded on experiment). But when experimental psychology shall lay hold of this art, it will give it a rational basis and make a science of it. From the historical point of view, graphology does not come to us from any science; it has a date of birth, but no scientific parentage, no genealogy.

Sociology which is still in embryo, is quite different. It is a true science and very abstract, entirely general, having need of very diverse positive knowledge. It is a result of other sciences, and of very diverse studies, which it summarises. It is a name applied to the general results of a great branch of science connected with the study of humanity, and is in a way the philosophy of all these studies.

Thus, we see from the example chosen, the difficulties are very great. Sciences are so little comparable to one another, that one cannot on *a priori* grounds eliminate any one or admit any new science into the general domain without preliminary study, and without considering the history of its development. The classification of sciences demands, as does that of organisms, a comparative anatomy and an embryological study of each individual member. This ought

to be made, but it should be made by specialists. It is for those who devote themselves to science, to study the mode of development of each branch of human investigation, because they alone are competent to dissect each science, to enumerate and define them, to trace their histories, and to make a classification.

The principle of a natural classification here proposed being admitted, one must not fail to meet the question and discuss it properly. The difficulties presented will be overcome by work. History will elucidate relationships, and it will put our knowledge in order. The genealogical tree will appear. The classification of science will be complete.

Bibliographers must not infer from all this that they have nothing to do while waiting. Far from it, the work they ought to furnish is immense. The complete index of scientific works will demand great efforts before its termination. This catalogue under authors will take many years; and it is only when the list is complete that it will be worth while to pull it to pieces to make a scientific and systematic bibliography. But for this grand preparatory work, detached indices suffice, granted that the sum of all the indices is complete. There is no need to recommence anew the work already accomplished, it is only necessary to complete what has already been compiled. The first step in this direction will be to make a Bibliography of scientific Bibliographies. The second step will be to hunt up and point out what has not been ransacked. A third will be to do what remains to be done.

It is this way that I have set to work. By means of detached indices I wish to complete the compilations of the Polish bibliographers, by adding to their work materials for a bibliography of scientific papers published in our language. I have invited my compatriots to aid me in this work, because it is not given to me to complete the work begun.

The notes collected up to the present, for a bibliography comprising the years 1800–1873, that is to say all the period which preceded the foundation of the Cracow Academy, suffice to give us an idea of the progress of the scientific activity of Poland. Progress can be expressed in figures, and these can be rendered graphically. By taking years as abscissæ, and the annual amount of scientific publication in Poland as ordinates, we obtain a curve which represents the varying scientific activity of the nation. This curve, which I have constructed, is very interesting though sad. It begins by a rapid rise —the influence of the brothers Sniadecki and of Staszic, three men who did much for their country. In 1805 the curve falls; then it grows by successive jumps to 1829, when it attains a high maximum. The "Society of Friends of the Sciences of Warsaw" is now the focus of activity. Then comes the year of the revolution: the curve falls abruptly, then breaks; in 1832 it is at zero. The Warsaw Society, founded by Staszic is no more; but that of Cracow has survived and

will prosper. The curve rises again, gently at first, then more rapidly and with a co-efficient of growth greater than in the homologous section of the first years. In 1841 and in 1844 we have two maxima greater than those of 1829: again we are on the eve of revolution. 1846: fatal year for Poland, and fall of the curve. It does not rise till after 1848, and attains a maximum in 1851. Then comes the Crimean War. The losses sustained by Russia lead her to exploit the Poles afresh; want of money causes a cessation of publication, and it is only after several years of fluctuation that the curve begins again to rise, again sharply till the eve of the revolution of 1863. But this fall is not so severe as the preceding, and from this moment the curve grows more and more rapidly; it has the form of the limb of a hyperbola.

I regret that I cannot prolong this curve for Poland to the present day. I also regret that I have not the necessary data to trace the curve of progress of scientific literature in Russia and Bohemia. But however that may be, the facts allow me to charge Alphonse de Candolle[1] with injustice. In speaking of the development of science in Poland and Russia, he only considers insufficient evidence, and, without taking the trouble to seek for the causes, he begins to philosophise. Now to philosophise it is necessary to have far better evidence than that now at our disposal, for even basing our arguments on Bibliography, on the Catalogue of Scientific Papers for example, we should equally arrive at entirely erroneous conclusions.

It is absolutely necessary that scientific men of all nations should take part in bibliographic work in order to obtain positive data. The great bibliography of scientific work—this Bibliography of the 20th century—must be really international, because it must be a monument to science, and not to the scientific activity of that group of nations which to-day are found at the head of civilisation. To arrive at a successful conclusion it is necessary before all not to deceive ourselves as to the aid that may be given by governments. And yet we do—unfortunately.

At the London Congress we saw a crowd of government representatives. English scientific literature was represented by the governments of the British Colonies, even of those that have as yet no literature of their own. Slavonic literature on the contrary had no government representative. Shall we be better off at future gatherings? We want to know also whether the Germans will cease their convention of considering German works published in Vienna, Prague or elsewhere, as German literature? Whether Finnish literature and the German literature of the Baltic Provinces will become, by similar convention, Russian literature? Whether the Poles will permit their literature to be divided among the governments on which they are dependent, and if, also by international convention,

[1] "Histoire des Sciences et des Savants," pp. 238–241.

the publications of the "Polish Society of Science of Paris," ought to be considered by the French *savants* as belonging to French literature? These questions appear ridiculous. Yes they are foolish, and yet they were not raised, so far as I remember, at the London Congress.

The fact is that the representatives of the governments have nothing to say and nothing to do at a congress on the bibliography of science. Science is for men of science, not for governments. It is to the interest of philosophers and of the learned societies to have this bibliography. But those who have no understanding of the matter take no interest in it: and governments are in this position. Governments are only migratory institutions, which science may exploit, but on which she must never depend, because science, which marches in great strides, must be free. The example of Poland will suffice. To-day still the Russian Government, far from aiding, does its best to choke intellectual development and culture in Poland; and though, in spite of all, science progresses on the banks of the Vistula as elsewhere in the civilised world, it is because science belongs to the world and not to the governments.

To conclude. If we must combine, it is for men of science to do it; for they alone can understand the principle of international solidarity, they, who, with sure and continuous step, march in the front of progress.

HENRYK ARÇTOWSKI.

London, *February* 15, 1897.

575.1
591.16

V.

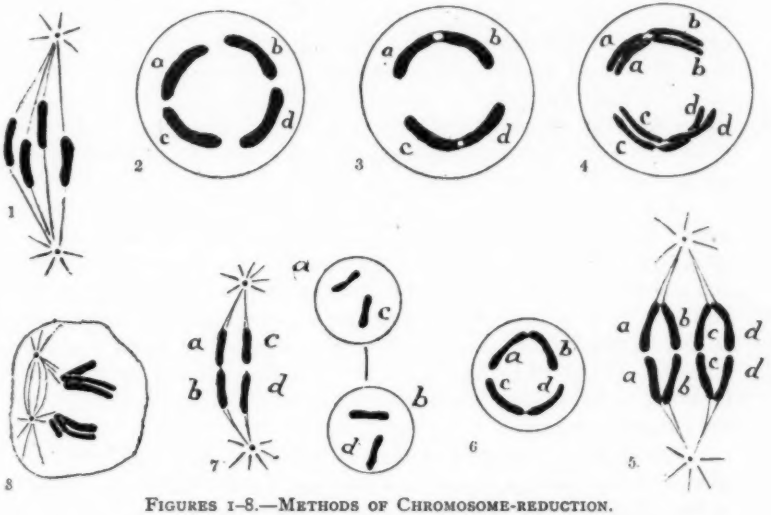
The Facts of Chromosome-reduction *versus* the Postulates of Weismann.[1]

IT is advisable that any new observations which bear upon the data supporting a popular theory should be widely known. The present article calls attention to the consequences which arise from the latest contribution to our knowledge of the maturation processes in sexual cells. As is well known, Weismann in the "germplasm" theory regarded the nuclear chromatin as the hereditary substance, while the chromosomes which always appear during nuclear division, in numbers that are fixed for each species, were supposed to contain equal quantities and qualities of hereditary units—"ids." In consequence of this hereditary equivalence of the cells, it is necessary that some reduction in the chromatin, the hereditary substance, should take place before fertilization can occur, since the essential process in fertilization is generally regarded as an interchange of half the hereditary substance of each of the conjugating cells. Weismann (1) was thus led to postulate as necessary the existence of peculiar divisions, in which this chromosome-reduction, or halving of the hereditary substance, could be brought about. The "Reductions-theilungen" or reduction-divisions as Weismann conceived them, consisted of final nuclear divisions during the formation of the sexual elements, in which half the original chromosomes passed unsplit directly to the poles, as in fig. 1.

Now, although it has been subsequently shown that such a process, if it exists at all, is not of general occurrence either among animals or plants, it is still maintained by Häcker (2) that the reduction postulated by Weismann may really be carried out, but in another way. It is agreed now among all observers, zoologists and botanists alike, that a halving of the *number* of chromosomes does actually take place, apparently universally before the maturation of the sexual elements. But this merely numerical reduction is not brought about by any nuclear division, it always follows a remarkable resting-

[1] Readers unfamiliar with the terms used in this paper will find an explanation of them, as well as a statement of the facts then known, in Mr. M. D. Hill's articles on "Cell-Division" in NATURAL SCIENCE, vol. iv., pp. 38 and 417, especially p. 425 (Jan. and June, 1894).—Ed. NAT. SCI.

stage in the maturation of the sexual cells, elsewhere termed by me the "synaptic rest" because this rest is universally followed by the disappearance of the regular number of somatic chromosomes and the evolution of half that number of chromatic rings (heterotype chromosomes). The succeeding heterotype division is generally followed by another, in which the same reduced number of chromosomes is retained. Now Häcker, together with Vom Rath (3) and Rückert (5), has maintained that this last division differs from the heterotype and all other mitoses, in that here the chromosomes split transversely, and not longitudinally as in every other observed case. If this is so, and if we assume as Häcker does that the synaptic rest results in the fusion of pairs of chromosomes end to end, then it will be seen that if we represent, say four chromosomes, typical of the



FIGURES 1–8.—METHODS OF CHROMOSOME-REDUCTION.

somatic divisions of any species, by the letters *a*, *b*, *c*, *d* (fig. 2), the effect of the synapsis will be to unite these chromosomes together in pairs as in fig. 3. In the ensuing division these double chromosomes ("plurivalent chromosomes" of Häcker) split longitudinally to form the double V's ("tetrads" of Häcker) as represented in fig. 4. These bodies subsequently divide, in the manner represented in fig. 5, to form two new cells each with two compound chromosomes, as in fig. 6; and according to Häcker, the final division is brought about by these compound chromosomes becoming disunited from one another and passing unsplit into each daughter-cell. It is thus possible to imagine that in this way a distribution of the chromosomes may be brought about exactly similar to that which Weismann originally conceived, and that this final transverse splitting may be really what Weismann's postulate requires.

It is, however, obvious that the probability of this or of any other process representing in reality a true reduction, depends absolutely on the universality of its occurrence. If, therefore, the process now put forward by Häcker, Rückert, and Vom Rath, as the "Reductions-theilung" can be proved to be in no sense universal, then we are not only without assurance that the process described by these authors *is* a "Reductions-theilung" at all, but there arises the greatest probability that, the final phenomena of maturation being thus conclusively demonstrated to be diverse, the theoretical value of reduction is annihilated altogether.

In 1894 the work which directly substantiated this new type of reduction was almost if not entirely restricted to observations made upon arthropods by the above-mentioned three authors. In 1894, however, Vom Rath (4) published a paper on the spermatogenesis of *Salamandra maculosa*, which not only flatly contradicted the previous careful work of Flemming (6), but which, if true, went far to establish the wide-spread and possibly universal occurrence of what we may call "the new reduction" in animal cells. It was the most important paper that the supporters of this type of reduction had produced, since in it Vom Rath unhesitatingly declared that the processes previously described in Arthropoda, also occurred in Amphibia in full.

It was impossible for me at the time to investigate the subject anew; but I subsequently (7) became quite convinced that so far as the maturation process in elasmobranchs was concerned, tetrad formation and reduction in Häcker's sense did not exist. It is hardly probable on the face of it that the cardinal points in the spermatogenesis of amphibians and elasmobranchs differ widely each from each; and the diametrically opposed character of Vom Rath's work and my own, led naturally to the enquiry whether one or other set of observations was not altogether wrong.

The answer to this question appears in a recent paper by Meves (8), who, with the full concurrence of Flemming, refutes almost the whole of Vom Rath's work. He shows in the first place that Vom Rath has fallen into the grossest error concerning the number of post-synaptic generations, that tetrad formation is in Amphibia, as Flemming had long ago ascertained, a rare abnormality, generally associated with degeneration phenomena. Lastly, and most important of all, he shows that the final division is a true example of longitudinally split, not transversely separating, chromosomes (fig. 8)—being in fact the very type from which Flemming originally made his description of the homotypic form of division. There is moreover, as Meves himself points out, the closest agreement between the processes I describe in elasmobranchs and the spermatogenesis of Amphibia. We have thus two more types which rank with Brauer's observations upon *Ascaris* (9), as directly contradicting the universality of the "Reductions-theilung" described by Häcker. Such being the case, it is obvious that these authors can no longer maintain the universal occurrence of this process,

and consequently the theoretical value of the remaining observations of Rückert and Häcker has in this respect vanished altogether.

Naturally I have no wish to question the accuracy of Rückert and Häcker's work on the Arthropoda. If the process they describe really occurs in these animals, it is certain that it simply exemplifies a diversity in the phenomena of maturation, which at once abolishes all the theoretical importance of reduction, in the sense in which these authors originally employed it. In fact it cannot be too clearly stated at the present time, that Häcker's, no less than Weismann's, attempt to support the theory of reduction on a basis of observed facts, has altogether broken down.

The state of our knowledge on this subject being then in the unedifying condition I have just described, it is not a little unfortunate that, in his work "The cell in development and inheritance" Professor Wilson should have given the by no means impartial description of these processes that is to be found in the chapters dealing with reduction.[1] As this book is popularly written, it is likely to be widely read, and the incorporation of erroneous observations in support of the theoretical conclusions it contains can only perpetuate that obscuration of the facts which the reiterated assertion of the universal occurrence of the new reduction has already produced.

J. E. S. Moore.

Royal College of Science,
London, S.W.

[1] On page 189 Professor Wilson also attributes to me the assertion that the ring chromosomes *do not* arise by a longitudinal splitting of a primary chromatin rod. Had he taken the trouble to read page 289 of my paper "On the . . . . . Spermatogenesis of Elasmobranchs (*Quart. Journ. Micro. Sci.* vol. xxxviii., Part II, pp. 275-313, 1895) before misquoting it, he would have found the following passage describing the origin of the heterotype rings: "The polarised thread-work is disposed throughout the nucleus in long parallel loops, the free ends of which, if they exist, are difficult to discern. After a time the threads begin to show longitudinal splittings, the double ropes thus formed dividing into equal segments, eventually giving rise to twelve thick loops, which form the twelve ring chromosomes, typical of the division of the second spermatogenetic period."

[*For Literature, see over.*

LITERATURE REFERRED TO.

1. **Weismann, A.**—"The Germ-Plasm." Pp. 235–236 of English translation. London, 1893.
2. **Häcker, V.**—"Die heterotypische Kerntheilung im Cyklus der generativen Zellen." *Ber. naturf. Ges. Freiburg*, vi., pp. 160–193, pls. x.–xii. 1892.
3. **Vom Rath, O.**—"Zur Kenntniss der Spermatogenese von *Gryllotalpa vulgaris* Latr." *Arch. für. mihr. Anat.*, xl., pp. 102–132, pl. v. 1892.
4. ————————.—"Beiträge zur Kenntniss der Spermatogenese von Salamandra." *Zeitschr. Wiss. Zool.*, lvii., pp. 97–140, pl. vii. 1894.
5. **Rückert, J.**—"Die Chromatinreduktion bei der Reifung der Sexualzellen· *Ergebn. d. Anat, u. Entwick.*, iii, pp. 517–583. 1893 (1894).
6. **Flemming, W.**—"Weitere Beobachtungen über die Entwicklung der Spermatosomen bei *Salamandra maculosa*." *Arch. für mihr. Anat.*, xxxi., pp. 71–97, pl. vii. 1888.
7. **Moore, J. E. S.**—"On the Structural Changes in the Reproductive Cells during the Spermatogenesis of Elasmobranchs." *Quart. Journ. Micr. Sci.*, n.s., xxxviii, pp. 275–313, pls. xiii–xvi. 1896.
8. **Meves, F.**—"Ueber die Entwicklung der männlichen Geschlechtszellen von *Salamandra maculosa*." *Arch. für mihr. Anat.*, xlviii, pp. 1–83, pls. i–v. 1897.
9. **Brauer, A.**—"Zur Kenntniss der Spermatogenese von *Ascaris megalocephala*." *Arch. für mihr. Anat.*, xlii, pp. 153–213, pls. xi-xiii. 1893.

591.3

VI.

Oscar Hertwig on Mechanics and Biology.[1]

THE first volume of Professor Hertwig's "Biological Problems of Today," that dealing with Preformation and Epigenesis, was summarised in these pages by its subsequent translator, Mr. P. Chalmers Mitchell, in August, September, and October of 1894 (NATURAL SCIENCE, vol. v., pp. 132–134, 184–194, and 292–297). A review of the English translation was published in our volume ix., pp. 270–271. In the second volume, which has recently been issued, Professor Hertwig has taken "Mechanics and Biology" as his theme, and treats the relation between these two branches of science from a very critical standpoint. The whole book is an energetic protest against the tendency of a certain school of writers, among whom Wilhelm Roux ranks as pre-eminent, to exalt mechanics as the science of the future, and to regard all biological, and especially embryological, phenomena as the outcome of purely mechanical processes.

The general question is discussed by Professor Hertwig in his introductory chapter, and the rest of the book deals more particularly with various attempts to elevate the so-called "mechanics of development" into a new and separate science. The goal to which this science of the future tends, and its methods, are discussed under separate headings, while a lengthy appendix, occupying nearly half the book, is devoted to a more detailed consideration of the laws of development according to Roux, or the "causal morphology" for which he claims such a high place.

Professor Hertwig is doing good service in leading a crusade against the over-glorification of mathematics, and the attempt to force biology into posing as one of the exact sciences. Apart from questions relating to pressures upon the skeleton and similar problems, mechanics in the strict sense have comparatively little to do with biology, and the introduction into zoological writings of words coined for another branch of science, and bearing therein a different connotation, can only lead to mystification. This is, however, an error only too prevalent among modern scientific writers of all nations. Our author draws attention to Roux's present use of the word "mechanics,"

[1] ZEIT-UND STREIT-FRAGEN DER BIOLOGIE. HEFT. II., MECHANIK UND BIOLOGIE. By Professor Dr. Oscar Hertwig. 8vo. Pp. iv., 211. Jena: G. Fischer, 1897. Price 4 marks.

not in its physical, but in a broad philosophical sense, and points out that the new-fangled word "Mechanik," used in this way, has no advantage over the old-fashioned term "Lehre." The latter covers the same ground, and at least cannot mislead. Now Lotze, in 1842, and Roux in 1880, both used the word "mechanics" to express widely-differing ideas. Lotze used it in the stricter physical sense, in opposition to certain writers whose vitalistic theories were supposed to explain all otherwise inexplicable phenomena of life; but Roux, while drawing attention to the work of Lotze, uses his word with a much wider and less definite meaning, in fact in several senses.

With regard to the newness and importance of Roux's doctrine of the causes of organisation, Professor Hertwig considers that his opponent deceives himself on both points. Seeing that Lotze in 1851 wrote of the mechanical explanation of life as a task to which more and more workers were then addressing themselves, it can hardly be reckoned as one of the latest developments of modern science. Kant, Wolff, and Schwann all had, in their turn, the same end in view. According to Kant, every science is a mechanical one, but to tack on the word "mechanics" to zoology and re-christen it "zoomechanics" in a general philosophical sense is not to create a new science. It is, however, with the methods of the "causal morphologists" that Professor Hertwig is most inclined to quarrel. Roux claims that zoomechanical methods are of primary importance, that those of the descriptive zoologists only prepare the way for causal investigators, and are of little or no intrinsic value: their very facts are scarcely worth having. Perhaps, if descriptive zoologists confined themselves, as Roux appears to think they do, to details of external anatomy, his strictures might have greater truth, but Professor Hertwig does not seem to consider Roux necessarily the best judge as to the value of facts supplied by the methods the latter depreciates. "To me," says our author, "nature is at least as trustworthy a teacher as the experimental anatomist." The methods upon which Roux lays most stress are those which he calls "analytical causal thought" and "intellectual anatomy," instruments of investigation which Professor Hertwig does not think will, unaided, be found very advantageous. Embryology is the branch of biology which can least be studied by analytical or mathematical methods, and the tendency of the "causal morphologists" to bring mainly these processes to bear upon biological—and especially embryological—problems, and to reject direct and constant observation in favour of purely experimental work, Professor Hertwig regards as mischievous. Experiment and observation should, he considers, go hand-in-hand, and there would be small chance of original discoveries of lasting value if experiment, instead of being a means to an end, came to be regarded as an end in itself. Probably many who think that merely statistical experiments are too often so regarded in these days will be inclined to agree with him. The great zoological discoveries of the age have certainly been

due more to the patient collection of facts and the stringing together of conclusions based upon observed sequences of these, than to experimental work alone. On p. 75, Professor Hertwig gives an instance from Roux's own work of the way in which one-sided experimental work may lead to erroneous or unsound conclusions; while he draws attention to the work of Dareste, Gerlach, Weismann, Boveri, Wilson, Morgan, and many others, both as a proof that he does not underrate experimental work in itself and that the best results are attained when observation and experiment are not divorced.

The last pages of the volume are devoted to a series of critical studies of Roux's laws of mechanical development, and deal with (1) the mosaic theory, (2) the so-called "copulatory track," (3) certain definitions, and (4) cytotropism.

The first study treats of Roux's view that the development of the gastrula in the frog is, from the first segmentation-furrow onwards, a piece of mosaic work (in that a perfect whole arises out of various independently differentiated parts), and, further, of the problem whether there is, or is not, a constant relation between the direction of the first plane of segmentation and the direction of the median plane in the resulting embryo. Professor Hertwig regards Roux's conclusion that there is such a relation as a preconceived theory, into which Roux has, in some Mikado-like manner, contrived to make his results "fit." In the case in question the results arrived at may be valuable or the reverse, but we think Professor Hertwig deviates somewhat from the path of fairness in the view he takes of them. Surely it is too much to expect of any investigator that he should start without a hypothesis at all; this would be the very experimenting "in's Geradewohl" which Professor Hertwig, in his neatly-chosen quotation from Johannes Müller, so deprecates.

In the second study Roux's theory as to the influence of the process of fertilization in determining the direction of the first segmentation-furrow is discussed, and somewhat severely handled.

The third study calls for little special mention, many of the questions therein raised having been already more fully dealt with in Part I. of this work, and already described in NATURAL SCIENCE.

The last chapter is devoted to a newly-discovered phenomenon described by Roux as "cytotropism," which Hertwig understands to mean a process, partially chemiotactic in nature, by which neighbouring cells in a segmenting ovum so react upon one another as to draw each other gradually into closer contact. Professor Hertwig makes a careful survey of the facts which have led to these conclusions, and believes that the former should bear a different interpretation. His comment is somewhat ironically expressed in a quotation from Roux's own writings, in which it is said to be "easier to establish a new fact than to arrive at a true estimate of its significance." In conclusion, Professor Hertwig sums up his own position with regard to these theories in three pithy paragraphs.

"(1) The direction of the first plane of segmentation and the planes of the embryo's body are independent of, and have no causal relation to, each other.

"(2) The process of segmentation does not result in the division of nuclear material into qualitatively dissimilar portions which determine the development of different parts of the body.

"(3) The fact that, in many cases, the planes of segmentation coincide more or less with the axes of the embryonic body, and that individual primitive organs are developed from definite areas on the surface of the ovum, is simply a consequence of the structure of the ovum itself, of its form, and of the distribution of protoplasm and reserve-material."

The book is written throughout in the author's usual lucid and readable style; the appendix is illustrated by a few diagrammatic figures which render the somewhat involved statements of Roux more intelligible; and there is an ample bibliographical list of works to which reference is made, as well as some additional notes.

L. J. VELEY.

22 Norham Road, Oxford.

SOME NEW BOOKS.

Newton's Birds.

A Dictionary of Birds. By Alfred Newton, assisted by Hans Gadow, with contributions from R. Lydekker, C. S. Roy, and R. W. Shufeldt. Part IV., 8vo. London: A. & C. Black. 1896. Price 7s. 6d. nett.

Professor Newton's Dictionary of Birds is just completed by the issue of Part IV. now before us. Viewing the book as a whole, one can gather a better idea of its scope, depth, and aims, as well as of its relative value as a work of reference, when contrasted with other ornithological works which have appeared lately. To estimate this book at its true worth is difficult. Its merits, perhaps, were never more justly appreciated than by the reviewer of the first part in the pages of Natural Science, vol. iii., p. 146, who described it as "marking an epoch" in the history of ornithology. None will realise the truth of this better than the serious student of ornithology, who has so many and such humiliating opportunities of sounding the depths of his ignorance. Such will ever feel grateful to the Professor and his colleagues for the vast amount of labour and research which they have expended upon their several contributions.

The present part contains the Preface and Introduction. This last occupies some 120 pages, wherein is passed in review the whole history of the rise and progress of ornithology from the days of Aristotle onward to the present time. It is really the Encyclopædia Britannica article recast and brought up-to-date. It should suffice then to say that it preserves all the charm and graceful ease of expression that characterised the original article.

Perhaps the most interesting of Professor Newton's contributions to this part are those on the Solitaire, Song, and Variation. In the latter the author subscribes to the view that those variations in intensity of colour usually regarded as instances of protective coloration—*e.g.*, the pallid colour of desert forms—are really due to climatic influences. The remarkable discontinuous colour-variations which occur amongst certain owls, night-jars, &c., are dealt with under the heading of Dimorphism, or better, as is suggested, Dichromatism. Finally, we are treated to a few brief remarks on abnormal colour-variations, such as Albinism, Melanism, Xanthochroism, and Erythrism; these are collectively grouped together under the head of Heterochrosis.

Dr. Gadow's articles maintain their high standard to the end. Indeed in some cases matter will be found which does not find a place in his larger works. In one instance, however, statements are made which certainly may justly demand further qualification. Thus, in describing the skull, certain membrane bones, to wit, the maxilla, pre-maxilla, quadrato-jugal, and jugals are described as modifications of the first visceral arch. This is surely heresy. Accompanying the description is an analytical diagram of the visceral arches, which, if it

is to be made intelligible to the majority of the readers of this book, needs some sort of explanation. As it stands the pre-maxilla and maxilla appear as if each represented a separate arch, though they are described as forming part of the first arch.

As touching the homologies of the spina pubica (pectineal process) and pubis of birds, Mehnert's view will probably find more favour than Miss Johnson's with the majority of those who have given the matter their attention. In describing the tectrices or wing-coverts, it is a pity that Wray's terms, Major, Median, Minor and Marginal coverts were not adopted, instead of "Greater, Middle, and Lesser," since in the plan the marginal coverts are left unnoticed. The Striges and Accipitres should be included with those groups in which the Median (Middle) and Minor (Lesser) coverts overlap *proximally*, and not, as is done, with those having a distal overlap. These, however, are not grave faults, and can easily be remedied should a second edition be called for—which is more than probable.

Nothing now remains but to offer, in the name of ornithologists generally, our hearty congratulations and deep gratitude to Professor Newton and his colleagues for this invaluable work, which will long remain the guide, philosopher, and friend of all who seek its help.

W. P. PYCRAFT.

BUTTERFLIES.

DIE SCHMETTERLINGSFAUNA VON HILDESHEIM. Von A. Radcliffe Grote A.M. Theil I.: Tagfalter. 8vo. pp. 44, pls. 4. (Mittheilungen aus dem Roemer-Museum, Nr. 8.) Hildesheim, 1897. Price 6 marks.

UNDER this modest title, suggesting a contribution to a local fauna, Mr. Grote has given us a valuable study on the classification and affinities of butterflies. Recently, various writers discussed in NATURAL SCIENCE the question, "Are the Arthropoda a Natural Group?" and several authorities were found to support the view that the animals now classed together as arthropods must be regarded as having reached their present organisation by development along two more or less parallel lines of descent. In the work before us, Mr. Grote puts forward a similar opinion with regard to the butterflies, which are perhaps the most familiar and most attractive of all arthropods. From a study of the wing-neuration in the different families, he concludes that while the Papilionidæ and Parnasiidæ have been derived from forms related to the geometers and notodonts, the rest of the butterflies are descended from *Castnia*-like ancestors. In the Papilios and their allies, there is always to be found the lowest of the sub-median nervures running from the root of the forewing to a point a short distance along the inner margin, while the middle sub-median nervure is always absent. In the rest of the butterflies, on the contrary, the lowest sub-median is always wanting, while the middle one is generally present. The principal types of neuration to be found among the butterflies are well shown in the four plates accompanying Mr. Grote's work. These plates are indeed entirely devoted to illustrations of wing-neuration.

It may be doubted whether Mr. Grote's radical division of the butterflies, founded as it is only on the arrangement of the wing-nervures, will meet with general acceptance among lepidopterists. In the search for the affinities of animal groups, weight must be given to a combination of characters, and in a dual division of the butterflies from any other point of view, the Hesperiidæ, and not the

Papilionidæ, would be set over against all the other families, as retaining in imaginal, pupal, and larval stages, a number of peculiar primitive features. But except for the position of the Papilionid group, it is of great interest to observe how closely Mr. Grote's view of the relationships of the families of butterflies agrees with the scheme, founded on pupal structure, lately put forward by Dr. Chapman.[1] Both authors reject Bates' arrangement founded entirely on the development of the front legs of the imago, and instead of considering the Lycænidæ and Lemoniidæ intermediate between the Pieridæ and Nymphalidæ, regard them as representing an offshoot not far above the Hesperiid stem; while they both place the Pieridæ much closer to the Nymphalidæ and allied families than to the Papilionidæ with which they were classed by Bates.

In the faunistic portion of his work, Mr. Grote enumerates eighty species of butterfly to be found in the neighbourhood of Hildesheim—ten more than occur in the whole of the British Isles.

G. H. C.

The Mosses of North America.

Analytic Keys to the Genera and Species of North American Mosses. By C. R. Barnes and F. D. Heald. *Bull. University of Wisconsin.* Pp. x., 157–368. Madison. December, 1896. Price 1 dol.

This is an official publication of the University of Wisconsin and forms a section of Vol. I. of its *Bulletin* (Science series). It consists of three parts—a Key to the Genera (now in its third edition), a Key to the Species (second edition), and a bulky Appendix containing 603 descriptions of species and varieties, which have been added to the North American Moss-flora between the date of publication of Lesquereux and James's "Manual of the Mosses of North America" (Boston, 1884), and the end of the year 1895. The Keys are intended to be employed in combination with the Manual, and in this function they make good what was a serious omission from that book—an omission which was not unnatural in view of the misfortunes which prematurely put an end to the work of the projectors of the Manual. Professor Barnes's Keys have been in public use for some years and have been of material assistance for the rapid determination of species. In their new and extended form they have gained much in value, and have almost been brought into line with our present knowledge of the North American moss-flora. Since the publication of the Manual copious additions have been made to the total of 900 species described in that work. Of these additions Mr. Heald has collected the descriptions and placed them in systematic order in the appendix, for which kindly office he deserves the gratitude of all who are interested in North American mosses, but especially of those who have not access to the periodicals in which these descriptions are scattered. It is probable that many of the species recently described will upon further investigation be found untenable. Indeed the work of destruction has already begun. In the genus *Dicranum*, for instance, seventeen out of eighteen species described as new in a Canadian catalogue by a European bryologist have been reduced. This is an extreme case no doubt, but it serves to shew that there is no great demand for new species of mosses in the United States, whatever may be the case with new species of other organisms. But be that as it may, the Analytic Keys have been carefully and intelligently constructed, and are well

[1] *Entom. Record*, vol. vi., pp. 150–2, 1895.

calculated to fulfil the purpose of the authors—to encourage and facilitate the study of the North American Moss-flora, and to lead to more accurate information as to the distribution and the degree of variability of the species. A.G.

"THE WHOLE WORLD KIN."

THE NEW CHARTER: a discussion of the rights of men and the rights of animals. Edited by Henry S. Salt. 8vo. Pp. xii., 156. London: G. Bell & Sons, 1896. Price 1s.

"THE six addresses included in this volume were delivered . . . before the Humanitarian League. . . . Each of the writers has . . . treated the subject from a quite independent standpoint. . . . The result has been a practically unanimous acceptance of the humanitarian principle." This Review is not concerned with "The Humanitarian View" presented by J. C. Kenworthy, with "The Church's View" by Rev. A. L. Lilley, with "The Ethical View" by Frederic Harrison, with "The Secularist View" by G. W. Foote, or with "The Theosophical View" by C. W. Leadbeater; but Mr. Salt will doubtless expect us to say something about "The Scientific View" as it is expounded to ordinary humanity by Josiah Oldfield, distinguished from the other writers by the addition of letters (M.A., B.C.L.) to his name. "*It is not scientific*," says Mr. Oldfield in italics, "*to take an unscientific dictum as the foundation for a scientific superstructure.*" Here are some dicta on which he bases the conclusion that "there is a true brotherhood of all that lives":—"If there is one fact of embryology more certain than another, it is in the practical identity of the history of all embryos. . . . The human only becomes human after passing anew and in rapid transit through all the histories of its past. . . . Thus is it that comparative embryology points out the title deeds to philogeny [*sic*] or the kinship of all that lives. Through the reptilic stages the germ of the infant life threads its mystic way." But it "does not stop there. It has an inherited gnosis which shows it how to pass higher still, and so through stages whence fish and bird branch off, until it reaches the higher vertebrates and mammals, and finally, it puts on the human form." Our readers can decide for themselves whether these dicta are scientific or unscientific; but to Mr. Salt and the Humanitarian League it is simple kindness to say: they are not science, they are bosh. Most scientific men, we venture to say, hold views more nearly coincident with those of Mr. Frederic Harrison; and, sympathising thus far with the objects of the League, they will regret to see that body accepting the turgid and misleading rhetoric of this Mr. Oldfield as representative of the support that Science, if seriously approached, might give.

FISH-MAKING AND FISH-TAKING.

LA PISCIFACTURE MARINE. Par M. le Dr. Marcel Baudouin. 8vo. Pp. iv,, 52. Paris: Institut International de Bibliographie Scientifique. 1897.

NORTHUMBERLAND SEA FISHERIES COMMITTEE, 1896. Report of the Scientific Results of the Trawling Expeditions during 1896. By Alexander Meek. 8vo. Pp. 26 & i. pl. 1897.

DR. BAUDOUIN plainly states in his "Introduction" that he has approached his problem as a scientific journalist and a "vulgarisateur modeste," but he has so mastered the details of the subject that the result is a connected Report upon the Rise and Present Position of

the Artificial Propagation of Marine Fishes, which cannot fail to be understood by any educated layman, and which, on the other hand, has points of interest for the ichthyologist.

Starting at Gloucester, Mass., the pioneer station of the movement, the author takes his readers a tour of inspection through the "hatcheries" of Wood's Holl (Mass.), Dildo (Newfoundland), Flœdevig (Norway), and Dunbar (Scotland). Each of these institutions in turn is graphically illustrated by views, bird's-eye-views, and plans, and their special work is alluded to.

There is one statement in the account of the Gloucester station (p. 12), upon which we would have desired more light. "Dès 1879 et 1880, on pêchait déjà, dit-on, dans la baie, des alevins de morue, qu'on reconnut à certains signes pour être nés au laboratoire en 1878 et les marins du pays leur donnèrent aussitôt la dénomination caractéristique et très honorifique de 'Morues de la Commission.'" The seafaring man is so often instinctively right that statements like these should be carefully investigated.

Perhaps the point which is best brought out, in this little report, is the comparative ease, combined with small pecuniary outlay, with which it is possible to hatch, and place in the sea, hundreds of millions of larval food-fishes, a fact of prime economical importance. Dr. Baudouin quotes the authority of such specialists as Mr. Dannevig and Mr. Nielsen to show that the 'hatcheries' are justifying the labour spent upon them, by a marked improvement in "the harvest of the sea." The author is an enthusiast, and, whilst more or less reconciled to the progressive strides of America, he would like to see his country abreast of Norway and Scotland, in an official attempt to recuperate the home fisheries.

If Dr. Baudouin's Report does not go far to bring about the desired result, it will not be due to the doubtful nature of its conclusions or the want of graphic exposition of the whole subject.

We have also received the Scientific Report of the Northumberland Sea Fisheries Committee, a little volume which is full of promise for the future. After a short account of the local fisheries, the results of trawling excursions are given. The most useful and interesting part of this is undoubtedly that dealing with the food of the fisheries, especially the local weakness of plaice for *Donax trunculus*. We would warn the author against a habit which is unfortunately only too prevalent with labourers amongst the eggs and larvæ of fishes. We refer to the issuing of plates illustrating the development of types which have already been fully worked out by others. The waste of money is not so important as the multiplication of literature involved. Mr. Meek is to be congratulated on the results of his labours, and we hope soon to hear of the successful establishment in his district of a marine laboratory with its attendant facilities for research.

We cannot pass from this subject without quoting the following delicious paragraph from the *Scientific American*, which, we hasten to add, disclaims any responsibility for its accuracy:

"In China the hen is kept constantly busy. When not engaged in hatching her own brood, she is compelled to hatch fish eggs. The spawn of fish are placed in an eggshell, which is hermetically sealed and placed under the unsuspecting hen. After some days the eggshell is removed and carefully broken, and the spawn, which has been warmed into life, is emptied into a shallow pool, well warmed by the sun. Here the minnows that soon develop are nursed until strong enough to be turned into a lake or stream."

THE STRATA OF THE EARTH.

CONGRÈS GÉOLOGIQUE INTERNATIONAL. 6E SESSION, ZURICH, 1894. CHRONOGRAPHE GÉOLOGIQUE. 12 grands tableaux en couleurs (gamme internationale). Texte explicatif suivi d'un répertoire stratigraphique polyglotte par E. Renevier . . . 8vo. Lausanne (Bridel & Cie). Mars, 1897. Compte Rendu du Congrès, pp. 523-695. Issued separately at 10 fr., or the tables without the text at 6 fr.

THIS chart of the sedimentary formations was first published by Professor Renevier in 1873 and 1874 in the *Bulletin de la Société Vaudoise des Sciences Naturelles*, volume xii., and consisted of nine tables. It is now enlarged to twelve tables, and published as a part of the Report of the Sixth International Geological Congress. The tables give a bird's-eye view of the homotaxy of the formations in different countries, and one can see at a glance the general correspondence of beds of similar age in different localities. The text explains the tables, and is followed by an extremely valuable "Répertoire Stratigraphique," which is in reality an alphabetical list of the names given to general or to local deposits in all parts of the world, followed in most cases by the authority for the name, and the date when it was founded. This alphabetical list will, we venture to think, be as indispensable to the geologists as de Margerie's Bibliography, noticed in our last number; and the veteran Swiss Professor will have the satisfaction of knowing that he has helped the internationality of geology to a very considerable extent by his indefatigable labours.

THE GLASTONBURY LAKE-VILLAGE.

IN 1893 (November) we referred to the Lake Dwellings discovered by Mr. Bulleid at Glastonbury, quoting Prof. Boyd Dawkin's address to the British Association. The excavations have been systematically carried out so far as the funds available have permitted, Mr. Edward Bath, the owner of the five acres, having generously given the site over for systematic exploration. An interesting and well-illustrated pamphlet, recently published at one shilling, gives an account of the work up to the end of 1896, and can be obtained of Messrs. Barnicott and Pearce, Fore Street, Taunton, or Mr. E. V. P. Barker, Glastonbury, the treasurer of the Excavation Fund, who will also be glad to receive any contributions towards the further exploration of this early British Settlement.

SCRAPS FROM SERIALS.

THE Bucharest *Anuaru al Biuroului Geologicu* has changed its title with the publication of the volume for 1894, which is just to our hands. It now reads *Anuarulŭ Museului de Geologia şi de Paleontologia*. At the same time there were published four sheets of the Geological Map of Roumania. This *Anuarulŭ* contains descriptions of fossil Camel and Dinothere found in the district, and of some rock-specimens from the Carpathians, etc. All praise is due to Gregoriu Stefanescu for his energy and perseverance in keeping science in evidence in Roumania.

Another of Mr. F. Enock's delightful and well-illustrated articles appears in *Knowledge* for May. It is called "The Insects of a London back-garden," and the first instalment deals with the willow saw-fly, *Nematus gallicola*, and its parasites. The same number contains articles on the progress of biology and geology during the Queen's reign, by R. Lydekker and Grenville Cole respectively. Mr. T. A. G. Strickland's photographs of animals in the Zoological Gardens are no doubt good enough, but the reproductions of them are excru-

ciatingly inartistic owing to the blocking out of all ground-tone, a feature on which Mr. Strickland seems to pride himself.

We have received volume V. of *The Journal of Malacology*, 1896, carefully bound up with the wrappers of the respective parts, as was to be expected of a periodical that devotes so much attention to bibliography. Besides the excellent annotated list of current literature, the volume contains communications from G. W. Chaster, E. A. Smith, A. S. Kennard, W. Moss, F. Stephenson, E. R. Sykes, and Professor T. D. A. Cockerell. Mr. W. M. Webb, the editor, is certainly to be congratulated on the appearance of his volume, printed by Mr. J. Dutton of Chelmsford.

New Serials.

A. Priber, of Berlin, announces the *Zeitschrift für Criminal-Anthropologie*, under the editorship of Dr. Walther Wenga.

La radiographie, edited by Dr. Paulin-Mery, deals with the medical and surgical applications of the Röntgen rays, and is published in Paris.

Der Deutscher Tierfreund is a monthly, edited by Dr. R. Klee, and published at Leipzig.

Further Literature Received.

The Forcing-book, L. H. Bailey; Experimental Morphology, C. B. Davenport; Rocks, Rock-weathering and Soils, G. P. Merrill: Macmillan, New York. Through a Pocket Lens, H. Scherren: Relig. Tract Soc. Handbook to the Birds of Great Britain, vols. iii. and iv., R. B. Sharpe: Allen. First Stage Physiography, A. M. Davies: Clive. Naturalists' Directory: L. Upcott Gill. Problems of Nature, Gustav Jaeger, Ed. and trans. H. G. Schlichter: Williams and Norgate. Genesis and Matrix of the Diamond, H. C. Lewis: Longmans. Young Beetle-Collector's Handbook, E. Hofmann: Sonnenschein. The Vertebrate Skeleton, S. H. Reynolds: Cambridge Univ. Press. Prehistoric Problems, R. Munro: Blackwood. Das Ellenbogengelenk, J. W. Hultkrantz; Lehrbuch der Zoologie, 1897, R. Hertwig: Fischer, Jena. Crustacea of Norway, vol. ii., Isopoda, pts. iii. and iv., G. O. Sars: Bergens Mus. Geological Structure of the Hill Slopes around Naini Tal, T. H. Holland: Geol. Surv. India.

Note on Computing Diffusion, G. F. Becker: *Amer. Journ. Sci.* Artificial Production of Certain Organic Forms, G. Rainey: *Rep. St. Thomas's Hospital.* Geological Evidence regarding the Age of the Earth, J. G. Goodchild: *Proc. Roy. Phys. Soc. Edinburgh.* Crater Lake, Oregon, J. S. Diller: *Nat. Geogr. Mag.* Hornblende-Basalt in Northern California, J. S. Diller: *Amer. Geol.* Mesial Fins of Ganoids and Teleosts, T. W. Bridge: *Journ. Linn. Soc. Zool.* Geographical Distribution of Dragonflies, G. H. Carpenter: *Proc. Roy. Soc. Dublin.* Distribution and habits of Puget Sound Invertebrates, N. R. Harrington and B. B. Griffin; *Rep. Trans. N. Y. Acad. Sci.* Deep-Sea Crustacea from South West of Ireland; On the Genus Anaspides, W. T. Calman: *Trans. Roy. Irish Acad.* Two New Species of Pterophyllum, J. Shirley: *Proc. Roy. Soc. Queensland.* Ratzel's History of Mankind, pts., 18 and 19. Considerazioni ed Appunti sul Cane cirneco, M. Migneco. Effects of the Weather upon Vegetation, J. Clayton.

Shooting Times, April 17, May 15; Amer. Geol., April, May; Scot. Geogr. Mag., May; Amer. Journ. Sci., May; Rep. Albany Mus., 1896; Amer. Nat., April, May; Victorian Nat., March–April; Journ. School Geogr., April; Botan. Gazette, April; Chivers' New Book List, May; Aeronautical Journ., April; Feuille des jeunes Nat., May; Illinois Wes. Mag., April; Irish Nat., May; Westminster Rev., May; Journ. Essex Tech. Lab., vol. ii. (1895–96), March–April; Journ. Malac., May; Proc. Biol. Soc. Washington, vol. xi.; Knowledge, May; Literary Digest, April 10, 17, 24, May 1, 8, Index; Naturæ Novit., April; Nat. Sci. Journ., April; Naturaleza (Madrid), viii., Nos. 11, 12, 13; Naturaleza (Mexico), 12; Jersey Times, May 12; Naturalist, May; Nature, April 15, 22, 29, May 6; Nature Notes, May; Naturen, April; Bull. U.S. Dept. Agric., No. 8; Photogram, May; Psychol. Rev., Index (1896), May; Revue Scient., April 17, 24, May 1, 8, 15; Science, April 9, 16, 30, May 7; Science Gossip, May; Scientific Amer., April 10, 17, 24, May 1, 8; Scot. Med. and Surg. Journ., May; Ann. Rep. New York Zool. Soc., 1.

OBITUARY.

ABRAHAM DEE BARTLETT.

BORN 1812. DIED MAY 7, 1897.

THE Zoological Society has sustained a severe loss by the death of the superintendent of the Gardens, aged 85. Mr. Bartlett had occupied that position since so long ago as 1859, having before that been head of the Natural History Department at the Crystal Palace. Few men had so great a practical acquaintance with animals as had Mr. Bartlett, and the Council of the Society will find it by no means an easy matter to appoint his successor. His contributions to zoological literature are mainly to be found in the *Proceedings* of the Zoological Society, and the most important of these deal with birds. He was the first to note the presence of powder down patches in that singular bird the Kagu (*Rhinochetus*), of New Caledonia, and also in the African *Balaeniceps*. He drew attention to certain struthious characters exhibited in the incubation and by the young of the tinamous—facts which tended to support the current views as to the low position of these birds among the Carinatæ. In the moulting of the penguin, Mr. Bartlett emphasised the interesting fact that the feathers of the wing, so scale-like in appearance, are shed almost in one piece as is the skin of a snake. He commented also upon the singular sac-like structures thrown up by the hornbill, and made a number of other contributions to our knowledge of the habits and structure of birds. The main part of his work, however, lay in the practical management of the Regent's Park Gardens, and the excellent condition of those gardens was in no small degree due to his industry and capabilities.

SIR EDWARD NEWTON, K.C.M.G., who died at Lowestoft on April 25, aged 64, availed himself of his opportunities as Colonial Secretary of Mauritius, as member of a mission to Madagascar, and as Lieutenant-Governor of Jamaica, to increase our knowledge of the natural history, and especially the ornithology of those islands. He was one of the founders of the British Ornithologists' Union, and was joint author of various scientific papers with Dr. A. Günther, Dr. H. Gadow, and his elder brother, Professor Alfred Newton.

THERE are also announced the deaths of:—MAX SINTENIS, Entomologist, at Kupferberg, Silesia; FILLIPPO TOGNINI, Curator of the Botanical Institute at Pavia University; on December 1, the explorer LUDWIG KÄRNBACH, aged 34; in January, at Libreville, M. THOLLON, a botanist and chief of exploration on the French Congo; on January 17, Professor AUGUSTO PALUMBO, at Castelvetrano, Sicily, aged 54; J. B. BARLA, head of the Natural History Museum at Nizza; Professor BERTHAUD, of Lille, geologist; G. GERCKE, of Hamburg, dipterologist.

WE are compelled by the exceptional pressure on our space in this number to hold over a large number of names.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced :—

Dr. J. Y. Mackay, Professor of Anatomy, to be Principal of University College, Dundee; Dmitri Klementz, to be Curator at the Museum of the Academy of Sciences, St. Petersburg; Dr. K. v. Buchka, to be Director of the Department of Scientific Enquiry at the Sanitary Office in Berlin; C. H. Townsend, to be Chief of the Division of Fisheries, and Dr. H. M. Smith, chief of the Division of Scientific Enquiry, U.S. Fish Commission.

Dr. J. Ritchie, to be Lecturer in Pathology at Oxford; Robert B. Yound, to be Assistant Biologist in the U.S. Department of Agriculture; Dr. Jensen, to be Privat-Docent in Physiology in the University of Halle; Dr. Max Siegfried, to be Professor-Extraordinarius of Physiology at Leipzig; Dr. Fritz Noll, to be Professor of Physiology at Heidelberg; Dr. Wladislaw Szymonowicz, of Cracow, to be Professor-Extraordinarius of Histology and Embryology at Lemberg; Dr. Polydore Francotte, to be Professor of Embryology at Brussels; Dr. Ludwig Heim, to be Professor-Extraordinarius of Bacteriology at Marburg; W. B. Pillsbury, to be Instructor of Experimental Psychology at Cornell University; J. F. Crawford, to be Demonstrator in Experimental Psychology at Princeton University; Dr. Simmara, to be Professor of Physiological Psychology in the Government School of Science, Madrid.

F. F. Blackman, to be Lecturer in Botany at Cambridge University; Dr. E. Fischer, to be Professor of Botany and Director of the Botanical Gardens at Berne; Dr. Victor Folgner, to be Assistant at the Botanical Institute of the German University, Prague; Anton Heinz, to be Professor of Botany at Agram; Dr. Noll to be Professor of Botany at Bonn.

Dr. Velain to be Professor of Physical Geography at the University of Paris; Dr. Mijat Kishpatitch to be Professor of Mineralogy at Agram; Dr. Siedentopf, of Göttingen, to be Assistant in Mineralogy at Greifswald University; Dr. Beckenkamp, of Mulhausen, to be Professor of Mineralogy at Würzburg; Dr. E. A. Wülfing, to be Professor-Extraordinarius of Mineralogy at Tübingen; J. H. Pratt, of Yale University, to be Mineralogist to the N. Carolina Geological Survey; C. H. Warren, to be Instructor in Mineralogy in the Sheffield Scientific School of Yale University; Dragutin Gorjanovitch Kramberger, to be Professor of Geology and Palæontology at Agram; Dr. F. Pompeckj, to be Curator of the Palæontological Collection in the State Museum at Munich; T. A. Rickard, mining engineer of Denver, to continue as State Geologist of Colorado; G. W. Stone, lawyer and politician, to be Mine Inspector of Kentucky; C. H. Crantz, steamboat agent, to be State Geologist of Illinois and Curator of the State Museum.

Nature for April 29 contains a statement made by the Duke of Devonshire, as Chancellor of Cambridge University, to the effect that the University is by no means the wealthy body it is often supposed to be. Agricultural depression continues to reduce the income of the University, while many of the museums, laboratories, and libraries, urgently demand extension, and new branches of study call in vain for recognition. Such a sad state of affairs likewise obtains at Oxford; and there is no doubt that a time has arrived when those with money to spare may well consider the re-endowment of our ancient seats of learning on a broader and firmer basis.

DR. NANSEN has sent a cheque for £50 to the Vice-Chancellor of the University of Cambridge, asking to be allowed to make a contribution towards the teaching of geography in the University. It is stated that Dr. Nansen is going to Australia to give fifty lectures; but it is not stated whether he intends to go *viâ* the South Pole.

IT is proposed to start a laboratory of experimental psychology at University College, London. For the present, instruction would be given for one term in each year. Subscriptions, to be devoted to the purchase of apparatus and the payment of a teacher, may be sent to the Hampstead Branch of the London and South Western Bank (a/c Psychological Laboratory, University College).

We learn from the *Scottish Medical Journal* that the Universities Commission has instituted a Chair of Public Health and Sanitary Science in the University of Edinburgh, to be known as the "Bruce and John Usher Chair of Public Health," in recognition of bequests from Messrs. Usher and A. L. Bruce. The salary of the Professor will be not less than £600.

SIR DONALD SMITH, who is Chancellor of McGill University, has provided funds for the establishment of a chair of Zoology.

POLITICAL changes in America have hitherto left the state universities untouched; but now *Science* announces with regret that the Populists, on securing a majority in the Board of Regents of the Kansas State Agricultural College, have dismissed a President who had served for eighteen years, to make room for a young man 'in harmony with the fundamental principles of the administration,' and have removed other members of the faculty and employees. In this connection the last two items in our list of appointments are full of interest.

MRS. STANFORD, widow of the railway millionaire, has taken out an insurance policy with the Mutual Life of New York, by which, if she dies within the next ten years, the Leland Stanford University will receive one million dollars, but if she survives that period, the sum will be two millions. The annual premium is 170,000 dollars, and the age of Mrs. Stanford is 71 years.

PROF. W. B. SCOTT of Princeton University, is taking a party of students to study the geology of S. Dakota, and to make collections for the University.

WE learn from *Science* that the building of the College of Agriculture at Berkeley Cal., has been burned.

THE United States Geological Survey has for some time been preparing a number of duplicate sets of 156 typical rock-specimens, for educational purposes. These are now ready for distribution to the chief universities and colleges of the country.

A DEPARTMENTAL Committee, consisting of Sir E. Hamilton, Sir A. Godley, and Mr. G. H. Murray, has been appointed to inquire into the organisation, pay, and duties of the staff of the British Museum, including the system under which the staff is recruited and the reasons for or against competitive examination, either limited or otherwise; the classification, scale of salary, and hours of attendance required to insure the efficient and proper discharge of the duties of the establishment, and whether it is practicable to assign clerical and routine work wholly or in part to clerks of the second division; and, generally, any matters connected with the Museum establishment in regard to which they may be of opinion that alteration of existing regulations is desirable.

THE town-council of Chelmsford has decided to commemorate Her Majesty's long reign by raising funds for a free library, museum, and technical institute.

A LARGE addition is being made to the Bergen Museum, from plans by the architect, Mr. Sparre. To the expected cost of £8,500, the Norwegian government has contributed half, while smaller sums have been given by the municipality of Bergen and by private persons. The number of visitors to this museum shows a steady increase, being 52,015 for 1896, of whom nearly four-fifths came on Sundays.

PROFESSOR ACHILLE TELLINI has published a long account of the Museum of Natural History in the R. Istituto tecnico "Antonio Zanon" in Udine, with a note on other collections in the city of Friuli. The notice appears in the *Annali* of the Institute, series 2, volume xiv., 1896 (1897). The museum was founded in 1866, and contains the Bartolomeo Gastaldi collection, and that of Giovanni Michelotti, beside many specimens given by Pirona, Taramelli, Zucchari, Brodmann, Bicknell, and Gropplero. The other collections to be found in Friuli, and shortly described in the pamphlet, are: the Museum of the "Jacopo Stellini" Lyceum; the Museum of Natural History of the Udine Archiepiscopal Seminary; the Provincial Museum of Natural History; those of the Gymnasium, and of the "Scuole reali" of Gorizia; and the Museum of Natural History at Trieste. Mention is also made of many private collections in the district.

AN Educational Museum was opened at the State House, Boston, U.S.A., on May 1. It includes, says *Science*, the exhibits of the Massachusetts schools at the Columbian Exposition, together with the work of other schools, school appliances, and a pedagogical library. Among educational appliances one might well include methods of museum installation; and such an exhibit would be of interest to many, whether at Boston or elsewhere.

THE Field Columbian Museum, Chicago, has purchased from the widow of Dr. Arthur Schott, the plants collected by him in Campeche, Tabasco, Upper Mexico, Hungary, and elsewhere.

THE following fifteen candidates are recommended for election by the Council of the Royal Society:—Dr. R. Bell, geographer of Canada; Sir W. H. Broadbent, the physician; Dr. C. Chree, of Kew observatory; Mr. H. J. Elwes, the entomologist; Dr. J. S. Haldane, the physiologist; Prof. W. A. Haswell, the zoologist, of Sydney; Prof. G. B. Howes, of the Royal College of Science, zoologist; Dr. F. S. Kipping, chemist, of the Central Technical College; Prof. G. B. Mathews, mathematician, of Bangor; Mr. G. R. M. Murray, Keeper of the Department of Botany in the British Museum; Mr. F. H. Neville, physicist, of Sidney Coll., Cambridge; Prof. H. A. Nicholson, of Aberdeen, invertebrate palæontologist; Prof. J. Millar Thomson, chemist; Dr. F. T. Trouton, physicist, of Trinity Coll., Dublin; and Mr. H. H. Turner, professor of astronomy at Oxford.

THE gold medal of the Linnean Society has been awarded to the renowned phycologist, Prof. Jacob Georg Agardh, of Lund University, Sweden.

AT the anniversary meeting of the Royal Geographical Society on May 17, the Founder's Medal was presented to Dr. G. M. Dawson, director of the Geological Society of Canada, an account of whose work, from the pen of Dr. G. J. Hinde, appears in the *Geological Magazine* for May last. The Murchison Grant of the same society is awarded to Lieut. S. Vandeleur, for surveying work in Somaliland, along the Abyssinian frontier, and in the Niger region. The Boeck Grant was presented to Lieut. Ryder, of the Danish Navy, and the Cuthbert Peek Grant to Dr. Thorwald Thoroddsen. Mr. C. E. Douglas received the Gill Memorial for his explorations of the New Zealand Alps.

THE 68th Annual Report of the Council of the Zoological Society, recently issued, shows that the number of Fellows on Jan. 1 was 3,098, an increase of 71 over the previous year, and that the income for 1896 was £27,081, being more than

£3,000 above the ordinary expenditure. This enabled a new house to be built, for the storks and cranes in one division of it, with 16 compartments, and the struthious birds in the other, with 12 compartments. The portion for the ostriches is kept at a higher temperature, and the arrangements enable the birds to remain on view in the same house all the year round. The number of animals in the Gardens at the close of 1896 was 2,473, an increase of 104 over the previous year; the difference was partly due to a decrease in the number of deaths, 986 as against 1,092 in 1895. Amongst the chief additions of the year were: A pair of a rather scarce species of Duiker antelope from West Africa, a silver-backed fox from Cape Colony, a young male manatee from the Rio Purus, a fine young female gorilla from French Congo-land, and also a very fine and large series of reptiles from Burma, collected by Mr. W. G. Bligh, and embracing specimens of fifteen species new to the collection.

THE American Association for the Advancement of Science is to meet at Detroit on Monday, August 9. The President was Prof. Cope, who is succeeded by the senior Vice-President, Prof. T. Gill; his address will take the form of an obituary of Prof. Cope. In place of the late Brown Goode, L. O. Howard has been nominated President of the Zoological section, while S. C. Chandler is elected auditor to replace yet another deceased officer, B. A. Gould. The Council of the British Association having specifically invited members of the American Association to attend the Toronto meeting on payment of a five dollar subscription, the American Association has replied by pointing out that members of all foreign scientific societies, are welcomed as honorary members of the American Association. "This is called the Retort Courteous."

THE British Medical Association is to meet in Montreal from August 30 to September 3, under the presidency of Dr. T. G. Roddick, Professor of Surgery at McGill University.

THE German Zoological Society will hold its 7th annual meeting at Kiel, under the presidency of Prof. O. Bütschli, on June 9–11.

THE Hayden medal has been awarded by the Philadelphia Academy of Natural Sciences to Prof. A. Karpinski, head of the Russian Geological Survey.

THE Hull Scientific Club had successful excursions at Easter in the neighbourhood of Flamborough. The botanists added *Cerastium tetandrum*, the mouse-eared duckweed, to the list of the East Riding flora. To judge from the report sent to us, this Club is in a condition of very healthy activity. Its members are helping in the formation of a collection of living British wild plants, which are being arranged in the Hull Parks.

THE Agricultural Society of Austria will hold an exhibition of agriculture and forestry in Vienna, from May 7 to October 9, 1898, The following sections will be of an international character: Machinery and implements for agriculture and forestry; dairy machinery and appliances: fertilisers, feeding stuffs, and chemical products for agricultural and forest purposes; veterinary science; agricultural improvements, building and engineering; agricultural and forest education, research work, statistics and literature.

AT the annual meeting of the National Academy of Sciences at Washington (20-22 April), the following papers were read, among others: Adelaide W. Peckham, "An experimental study of the influence of Environment upon the biological processes of the various members of the Colon group of Bacilli"; T. C. Mendenhall, "The energy involved in recent Earthquakes"; A. Agassiz, "Recent borings in Coral-reefs"; and T. Gill, "The position of the Tarsiids and relationships to the

Phylogeny of Man." This last should interest readers of Dr. C. Earle's recent paper in NATURAL SCIENCE. During the meeting Sir A. Geikie was formally introduced to the Academy.

Science states that the physiological library of the late Professor Du Bois-Reymond has been bought by Dr. Nicholas Senn, and presented by him to the Newberry Library, Chicago. On the other hand, according to *Die Natur*, these same books have been bought by the Prussian Government on behalf of the Physiological Society of Berlin.

THE twenty-fifth anniversary of the foundation of the Zoological Station at Naples was celebrated on April 14, when addresses were presented to Dr. Anton Dohrn from learned bodies in all parts of the world, and one signed by some two thousand naturalists of Europe. Dr. Dohrn was admitted to the freedom of the city of Naples, and received the Grand Order of the Crown of Italy.

THE annual report for 1896 of the Millport Marine Biological Station, informs us that the good seed planted by Dr. David Robertson is bearing fruit. The mason work of the main building is completed, and the structure was to be finished and opened in May. Unfortunately, Dr Robertson has not been spared to see the crown of his long and active life. The funds in hand have sufficed for the construction, but another £300 will be wanted for fittings, etc. Since 1894, "The Ark," lent by Dr. John Murray, has formed a temporary station, and has proved useful to a small number of investigations, and it is hoped that the completion of the permanent structure will see a large influx of scientific workers, for the possibilities of Cumbrae are perfectly well known to all those who have followed Dr. David Robertson's life-work.

NOTWITHSTANDING rather boisterous weather, the usual Easter expeditions of the Liverpool Marine Biology Committee, were carried on with success, and the Port Erin Biological Station has never been so full of workers as it was during April. During the actual Easter vacation, the rather limited accommodation was more than fully occupied. The Lancashire Sea-Fisheries Steamer, has been at Port Erin during the Easter week, carrying on her trawling investigations of the district; and several dredging expeditions have been made in her. Spawning fish have been procured to the West of the Isle of Man, and the tanks in the Biological Station now contain developing lemon soles, and witches, and a cross between *Myxine* and the cod.

There is to be an "international" fisheries exhibition at Bergen, from May 16 to Sept. 30, 1898. And there is to be a "national" fisheries congress at Tampa, Florida, on Jan. 19, 1898.

Mr. A. GIBB MAITLAND, late of the Geological Survey of Queensland, has been appointed government geologist of West Australia, and is reorganising the staff with the view of making a proper geological survey of the mining fields of the colony, and publishing maps of the same. As a preliminary to this a topographical survey is being prepared with the assistance of a topographer. An important addition to the staff is Mr. Torrington Blatchford, of the Sydney School of Mines, who has had much practical experience of mining geology. Applications have also been invited by the Government for the position of assistant geologist; while as mineralogist and assayer there has been appointed Mr. Simpson of the Sydney School of Mines, late chief assistant assayer to the Mount Morgan Co., Queensland. A lithographic draughtsman and a clerk complete the not over-large staff, which has a large and important task before it.

PROF. W. B. DWIGHT of Vassar College, Poughkeepsie, has invented a machine for cutting sections of rocks, minerals, and fossils. The object can be held so as to

produce a cut in exactly the desired direction. Sections of from eight to twelve square inches, with a thickness of one-fiftieth to one-hundredth of an inch, can be cut with true smooth surfaces.

AT the Tennessee Exposition, which opened on May 1, the U. S. Government has interesting scientific exhibits; those illustrating the work of the Department of Agriculture are specially complete. The Bureau of Ethnology has concentrated its energies on a representation of a Kiowa camping circle.

THE progress of skiagraphy in medicine and surgery is rapid. A very complete installation was sent out to the seat of war in Greece, by the *Daily Chronicle* ambulance fund, and was of great help in localising bullets. A laboratory for the purpose has been founded at the Trousseau Hospital by the Municipal Council of Paris.

ACCORDING to *Science*, Prof. Lawrence Bruner, of the University of Nebraska, sailed on April 27 for Buenos Ayres, where he will spend a year investigating the injurious locusts which have of late increased enormously in three of the eastern provinces of the Argentine Republic. The expenses are paid by a committee of Buenos Ayres business men.

ON his forthcoming Arctic Expedition, Lieut. Peary intends to take with him Esquimaux, not only men but women. The Esquimau is a pronounced family-man, and prefers his wife to the North Pole.

THE administration of the grants to schools in Scotland for science and art is to be transferred to the Scotch Education Department. The details of the transfer will be matter of departmental arrangement.

WE learn from our always interesting contemporary, the *Shooting Times*, that General Sir Julius Raines has decided to bequeath to the nation his fine collection of Japanese masks made of fossil mammoth ivory.

A SEVERE earthquake took place in the West Indies on April 29. The island of Montserrat seems to have been about the centre of the disturbance; but most loss of life occurred in Guadeloupe, while Antigua also suffered severely. An earthquake also occurred at Lima at 2 a.m. on May 1.

THE chapter-house at Canterbury, which has been magnificently restored under the direction of Sir Arthur Blomfield, will be re-opened by H.R.H. the Prince of Wales on Saturday, May 29. Dean Farrar asks us to state that at 2 p.m. on May 31, Sir Henry Irving will read Tennyson's "Becket" therein, for the benefit of the Thirteenth Centenary Fund. St. Thomas Becket entered the chapter-house on the evening of December 29, 1170, only a few minutes before his murder. Reserved seats for the reading may be procured, at one guinea each, by letter to Mr. Crow, Mercery Lane, Canterbury.

UNDER the title of the Kent Coal Exploration Co., Limited, a company has just been floated to explore for minerals, especially coal and iron, by means of deep borings, in the County of Kent and elsewhere in the South of England. There is already a Kent Coal Fields Syndicate, Limited, with which the present company will co-operate. It is proposed to enter into conditional agreements with landowners to explore for the Coal Measures, in consideration of the grant of leases of minerals at royalties. All the borings may not be immediately successful in finding coal, but each will throw fresh light on the structure of the country, and the details will be eagerly followed by geologists no less than by those in search of dividends.

CORRESPONDENCE.

The Presidency of the Chemical Society.

In the May number of Natural Science you have called attention to the recent contest for the presidency of the Chemical Society, and the extraordinary character of the two circulars put forward by prominent members of the official party in the Society has been very justly commented upon by you.

I shall regard it as a favour if you will permit me to supplement your notice with a statement of the facts which have come to light.

The total number of votes recorded at the anniversary meeting was about 380, and the number of votes for Dewar has been officially declared to be 166. It is, therefore, quite clear that Dewar did not receive the votes of a majority of the voters. There were about 214 votes, cast by voters, who certainly indicated their will that Dewar should not occupy the presidency,

Inasmuch as the names of both Dewar and Ramsay had been, in the most formal manner, proposed for the presidency, the 214 must be taken as votes for Ramsay. I am informed, however, that, on the first Thursday in this month the statement made from the chair at the meeting of the Society was that the votes for Ramsay were 152, and that no mention was made of the 62 votes, which apparently were regarded as void.

J. Alfred Wanklyn.

11 May, 1897, Laboratory, New Malden, Surrey.

[We have verified Dr. Wanklyn's statement, which indicates a more serious attempt on the part of the Council to override the will of the Fellows than we had suspected. According to the Charter of the Society, the President must be elected by a majority of those voting; this condition has not been complied with. There is nothing in the Charter or Bye-laws of the Society to justify the rejection of votes which, though of clear intention, did not absolutely comply with all the requirements of a cumbrous ballot-paper. We conclude that Professor William Ramsay is legally the President of the Chemical Society, and we hope that the Fellows will see their will enforced.—Ed. Nat. Sci.]

The Numerical Variations in *Ranunculus repens*.

Upon closer examination of my figures, I find, that the whorls of *Ranunculus repens* do *not* vary independently as previously stated (Nat. Sci., May, 1897, p. 325), only 39 per cent. of the possible variations being recorded. As I am about to proceed with a second series, I will reserve further particulars for a future occasion.

115 Richmond Road, London, N.E. John H. Pledge.

[Others than Mr. Pledge will see with pleasure that the *Revue Scientifique*, after devoting a column to an account of his paper, concludes: "Mr. Pledge's work is conscientious; in such matters there is need of care and a spirit of accuracy, and this is undoubtedly an example that might be followed by many with profit to science."—Ed. Nat. Sci.]

Polychæta in the Cambridge Natural History.

It would be a pity if Mr. Goodrich's "gratitude" and "wonder" were to lead him to use the book he esteems so highly as the basis of future researches on the Polychæta. If this were, as Mr. Goodrich says it "undoubtedly" is, "the best general account" of the group "in any single work, in any language," I should feel sorry indeed for all who are intending to devote their energies to this particular field of zoology. Nor do I think that the author himself would claim such high rank for his work. No one who is at all familiar with the admirable monograph of Eisig—

which, though it professes to deal with a single family only, really deals in a most comprehensive and suggestive manner with the morphology of the whole group to which that family belongs,—could hesitate for a moment in declaring it far and away the best "*modern attempt* to deal in a broad, yet thorough manner with the group Polychæta." And, even were it not for Eisig amongst others, Dr. Benham could hardly be described as the "*first*" to make the attempt in modern times when we remember the names of Ehlers, Grube, Von Marenzeller, Hatschek, Saint-Joseph, Gravier, and Racovitza, all of whom, in the last twenty years, have not only made the attempt, but have been by no means unsuccessful in so doing. I am well aware that Eisig does not deal in detail with the appendages of the head and the minute forms of the chætæ in the different families, but I should have thought that no one claiming to be a "student of the anatomy of the Polychæta" and to have been so, I believe, for some years, could fail to have discovered how little reliance can be placed on such external features, and to perceive that it is to the internal anatomy that we must look for the solution of the many puzzling problems in the morphology of these worms which may help us to a "clear understanding of their classification."

It seemed to me that your reviewer erred rather on the side of leniency than otherwise, in that he chose a few small points to find fault with when there were many more important statements in the book, the incompleteness of which would lead one who knew nothing about the subject to infer the exact opposite of the truth. And it is, to my mind, no excuse to say that in some cases (it would not be true to say "in all") the statement may, if looked for, be found elsewhere in the book accurately made and with its necessary qualifications, but rather the admission of a second fault, for space might have been saved with great advantage, and room left for important facts which find no place in the work, by stating a fact but once. The author, for instance, might have made up his mind *either* to draw comparisons after dealing with each organ (or system of organs) in his type genus, *or* to devote a separate chapter to comparisons. It was not necessary or desirable to do both.

You would probably not allow me space to point out some of the many "misleading statements" (as I will call them for Mr. Goodrich'se dification) which seem to me of more consequence than some of those mentioned by your reviewer. But there is one point which I feel, in the interest of all future students of the Polychæta, should not be passed over without comment. The "Cambridge Natural History Series is intended," we were originally told by the publishers, "in the first instance for those who have not had any special scientific training." Now I imagine that any such person, after perusal of the chapters we are here considering, would conclude that the classification given on p. 258 and dealt with more fully in chapter xii., was the one generally accepted by authorities on the Polychæta. I venture, however, to think that no one of the great authorities of the group would for a moment admit a classification which (amongst other things):

(1) Separates such closely allied families as the Capitellidæ, Opheliidæ, and Maldanidæ by placing them in two distinct suborders, while leaving such totally dissimilar families as *e.g.* the Aphroditidæ, Syllidæ, Tomopteridæ, Glyceridæ, and Typloscolecidæ in one suborder;

(2) Nowhere gives any indication as to the relationship between the families in a suborder (unless perchance the order they are placed in is meant to have some such significance), nor of one suborder to another;

(3) Takes no account of such important genera as *Staurocephalus* and *Spiochætopterus*, to say nothing of *Palmyra* which, though important, is not common, and of *Gattiola* (*Amblyosyllis*) and *Sabellides*, which, though fairly common, are of rather less classificatory importance;

(4) Leaves such genera as *Spinther*, *Euphrosyne*, and *Amphinome* in one family while making two distinct families of the Spionidæ and Polydoridæ;

(5) Places families which pass almost imperceptibly into one another in distinct suborders (Spionidæ and Cirratulidæ), or even Orders (Spionidæ and Amphicorinidæ, though here we must remember Mr. Goodrich's information that Dr. Benham does not agree with those who have most carefully studied the subject).

One is unaccustomed now-a-days to see such a purely artificial classification introduced as an improvement upon others, and it is scarcely fair to impose on the untrained scientific mind by giving, as though there were no question about its sufficiency, an entirely new classification which has not been confirmed and accepted by men who are competent to form an opinion on the subject. It is true that, as Dr. Benham points out, he had published his classification before (though with one Suborder in a different Order, and two families in a different Suborder than they are now!); but would any authority on the Polychæta, even had the brief notice in the *Report of the British Association* come to his notice, have thought it worth while to confute a classification with so few facts given to support it, and with apparently no account taken of the main difficulties which every one who attempts to classify the Polychæta has to encounter? Silence in this case cannot fairly be taken for consent. To anyone who has made a study of the Polychæta there is only one thing which Dr. Benham's classification shows, and that is which of the forms have been particularly studied by him either directly or indirectly. It is quite evident that, with the aid of Eisig, he knows a good deal about the Capitellidæ, and so much is he impressed with their importance that he wonders (p. 303) whether he should not have given the family an even more prominent position than he has, presumably thinking of making it a separate order on a level with the Oligochæta or Myzostomaria, as opposed to all other Polychæta. Had only Eisig written as elaborate a monograph on every family of the Polychæta, it is probable that Dr. Benham would have allowed each one as important a position in the system as he now assigns to the Capitellidæ As it is, Dr. Benham has had to make out what he can about the other families for himself, and his opportunities for doing so have not been all that could be desired. He has evidently studied some of the British forms most carefully, and has carried his patriotism so far as to assume that they may be allowed to give the key-note to the whole classification, forgetting that it is in warmer seas than ours that these annelids occur in greatest variety.

Those who have made no special study of the Polychæta will accept such a classification unhesitatingly, in the same way as they will accept other statements in the book, though by no means established facts, the author going so far in one case as to assume that investigations of his own as yet unpublished may be taken as evidence against the most careful researches of other writers, a course which his ardent admirer seems to uphold.

Had it not been for the excessiveness of the eulogy bestowed upon the work by this admirer, I would not have felt bound to dwell upon nothing but the shortcomings in the fulfilment of a task, the difficulty of which no one can appreciate more fully than myself. Although my own opinion is that it is better not to publish anything, and especially not for the untrained scientific mind, until all the facts that *are* known are mastered and digested, I am well aware that the risk is thereby run of never publishing at all knowledge which may have taken years to acquire, and that others may think they are furthering science more by publishing than by withholding their preliminary halting-places on the road (which may or may not be the direct road) to knowledge.

University College, London. F. Buchanan.

The Extermination of the Golden Eagle.

Referring to your remarks at pp. 303–4, I should like to be allowed to say that Mr. Joseph Collinson will do good service to British ornithology, and especially to Yorkshire faunists, if he can substantiate the two records of golden eagles said by him to have been killed in that county within three months; the two Scotch instances are unhappily too likely to be correct, and are much to be deplored, as they were probably breeding birds. As for the Yorkshire specimens, I incline to Mr. Murdoch's opinion, and my experience has been long and extensive, that the species is incorrectly reported. Of the many reputed golden eagles which I have traced, not one has proved to be of that species, and south of the Tweed all reports of the occurrence of this bird should be received with the greatest caution. Messrs. Clarke and Roebuck in their Vertebrate Fauna of Yorkshire enumerate seven instances of the occurrence of the golden eagle in Yorkshire since the year 1804, all

of which I do not think they would like to vouch for; Mr. Cordeaux has not one to report for Lincolnshire, and the only claim Norfolk can advance to this species is founded upon the remains of one found upon a salt marsh at Stiffkey in December, 1868. The fact is that the so-called English "golden eagles" are the young of Continental bred white-tailed eagles, and these are not at all uncommon along the east coast during the autumn migration, but the adult birds are extremely rare, and I do not know of a single mature individual having been met with in the counties named, and of only one which had made considerable approach to maturity. Mr. Collinson's "sentiments" may be very admirable, but they certainly are not judicious, nor are they likely to be fully shared by the Home Secretary who will require more weighty evidence than he adduces before making the drastic order suggested; nor does Mr. Collinson seem to be aware what measure of protection is being *voluntarily* exercised by certain proprietors in Scotland and the Isles. I think I am justified in saying that the golden eagle is in no immediate danger of extermination in the northern division of the kingdom, but is probably even increasing in numbers. I am an advocate for persuasion rather than coercion in such matters, and would prefer to trust to the friendly action of those who have the power to protect these birds—and I do not think on the matter being fairly laid before them this is very difficult to procure—rather than to the doubtful enforcement of a possibly obnoxious law. Personally I am strongly in favour of judicious protection of most birds during the breeding season, and I have persistently written and worked to that end; but if we stigmatise a man as a "butcher" for killing out of the close time a passing migrant, which under no circumstances could be expected to take up its residence with us, however much we may regret the event, I fear we are more likely to harden his heart than to convert him. I have seen but one of the leaflets of the Humanitarian League (Leaflet No. iv.), and in that the snowy owl is spoken of as one of the birds "rapidly disappearing" in this country. Such questionable ornithology is, I fear, not calculated to add weight to the Society's advocacy.

Norwich, May 3rd, 1897. THOMAS SOUTHWELL.

"BUFFALOES" IN NORTH AMERICA.

It must have surprised many readers of NATURAL SCIENCE to notice in an editorial comment in last month's number (p. 304) the common but incorrect application of the name "buffalo" to the American Bison. The "*Scientific*" *American* ought to be aware that there are no true buffaloes in the whole American continent. It is a still greater shock to find NATURAL SCIENCE taking up and perpetuating such an error in animal nomenclature.

I hope this will not be regarded as a merely pedantic plea for the correct use of words. When animals have well-known English names, it is most desirable that they should be used on all possible occasions, if they be used correctly. If not, they become highly misleading, giving rise to utterly false views of geographical distribution. Within the last few months in the course of miscellaneous reading I have met with North American "buffaloes," South American "baboons," and South African "deer" and "wolves."

Science and Art Museum, Dublin, May 11, 1897. G. H. CARPENTER.

ERRATUM.

P. 333, line 7 from bottom, for "Walker" read "Walter."

SPECIAL NOTICE.

TO CONTRIBUTORS.—*In future all communications must be addressed to the* EDITOR *of* NATURAL SCIENCE, *at* 67 ST. JAMES'S STREET, LONDON, S.W.

TO THE TRADE.—*The present Number is published as usual by* MESSRS. PAGE & PRATT.

Orders for the July Number, and all business communications after June 25th next, to be addressed to MESSRS. J. M. DENT & CO., 67 ST. JAMES'S STREET, LONDON, S.W.

THESE titles may be cut out and pasted on cards for a slip-catalogue. Those who do not wish to use the decimal notation as a guide to the subject matter, can cut off the numbers.

---

010. **Arçtowski, H.** The Genealogy of the Sciences as the Basis of their Bibliography.—*Nat. Sci.*, X., 395 **June, 1897**

154. **Edinger, L.** Have Fish a Memory? A chapter in the Evolution of the Brain.—*Nat. Sci.*, X., 118 **Feb., 1897**

500.(931) **Editor.** Science in New Zealand.—*Nat. Sci.*, X., 192 **March, 1897**

507. **Cumming, L.** The Museums of Public Schools III.—Rugby—*Nat. Sci.*, X., 314 **May, 1897**

508.3(942) **Editor.** The Horn Expedition to Central Australia.—*Nat. Sci.*, X., 254 **April, 1897**

509. **Arçtowski, H.** The Genealogy of the Sciences as the Basis of their Bibliography.—*Nat. Sci.*, X., 395 **June, 1897**

535.7 **Bernard, H. M.** The Light-Sensations of Eyeless Animals.—*Nat. Sci.*, X., 173 **March, 1897**

560.7 **Editor.** Additions to our List of Palæontological Specialists.—*Nat. Sci.*, X., 122 **Feb., 1897**

565.3309 **Sherborn, C. D.** The Literature of Fossil Ostracods.—*Nat. Sci.*, X., 181 **March, 1897**

571.14 **Abbott, W. J. L.** Worked Flints from the Cromer Forest Bed.—*Nat. Sci.*, X., 89 **Feb., 1897**

571.15(592) **Noetling, F.** On the Discovery of Chipped Flint-flakes in the Pliocene of Burma.—*Nat. Sci.*, X., 233 **April, 1897**

571.71 **Haddon, A. C.** The Earliest Known Seat of Learning in Europe.—*Nat. Sci.*, X., 33 **Jan., 1897**

575. **Bather, F. A.** Cope's "Factors of Evolution."—*Nat. Sci.*, X., 37 **Jan., 1897**

575. **Buckman, S. S.** Human Evolution II.—According to Mr. G. Archdall Reid.—*Nat. Sci*, X., 187 **March, 1897**

575. **Common, T.** Human Evolution. V.—According to Nietzsche.—*Nat. Sci.*, X., 393 **June, 1897**

575. **Coste, F. H. P.** Human Evolution. I.—According to Mr. H. G. Wells.—*Nat. Sci.*, X., 184 and 244 **March & April, 1897**

575. **Reid, G. A.** Human Evolution. IV.—Mr. Archdall Reid States his Position.—*Nat. Sci.*, X., 305 **May, 1897**

575. **Wells, H. G.** Human Evolution. III.—Mr. Wells Replies.—*Nat. Sci.*, X., 242 **April, 1897**

575.1 **Moore, J. E. S.** The Facts of Chromosome-reduction *versus* the Postulates of Weismann.—*Nat. Sci.*, X., 406 **June, 1897**

575.2 **Pledge, J. H.** Numerical Variation of Parts in Ranunculus repens.—*Nat. Sci.*, X., 323 **May. 1897**

583.111 **Pledge, J. H.** Numerical Variation of Parts in Ranunculus repens.—*Nat. Sci.*, X., 323 **May, 1897**

590.1 **MacBride, E. W.** The Position of Morphology in Zoological Science.—*Nat. Sci.*, X., 20 **Jan., 1897**

590.7(4) **Fritsch, A.** Fresh-water Biological Stations: Europe's Example.—*Nat. Sci.*, X., 169 **March, 1897**

590.7(42) **Scourfield, D. J.** Wanted, a British Fresh-water Biological Station.—*Nat. Sci.*, X., 17 **Jan., 1897**

591.3 **Yeley, L. J.** Oscar Hertwig on Mechanics and Biology.—*Nat. Sci.*, X., 411 **June, 1897**

591.14 **Collinge, W. E.** The Suprarenal Bodies of Fishes.—*Nat. Sci.*, X., 318 **May, 1897**

591.16 **Masterman, A. T.** Some Effects of Pelagic Spawning-habit on the Life-histories of Teleostean Fishes.—*Nat. Sci.*, X., 382 **June, 1897**

591.16 **Moore, J. E. S.** The Facts of Chromosome-reduction *versus* the Postulates of Weismann.—*Nat. Sci.*, X., 406 **June, 1897**

591.18 **Edinger, L.** Have Fish a Memory? A chapter in the Evolution of the Brain.—*Nat. Sci.*, X., 118 **Feb., 1897**

591.44 **Collinge, W. E.** The Suprarenal Bodies of Fishes.—*Nat. Sci.*, X., 318 **May, 1897**

591.48 **Edinger, L.** Have Fish a Memory? A chapter in the Evolution of the Brain.—*Nat. Sci.*, X., 118 **Feb. 1897**

591.51 **Wallace, A. R.** The Problem of Instinct.—*Nat. Sci.*, X., 161 **March, 1897**

591.52 **Southwell, T.** The Migration of British Birds.—*Nat. Sci.*, X., 245 **April, 1897**

591.185 **Bernard, H. M.** The Light-Sensations of Eyeless Animals.—*Nat. Sci.*, X., 173 **March, 1897**

595.2 **Hutton, F. W., Bernard, H. M., Carpenter, G. H., Claus, C., Hansen, H. J., Jaworowski, A. von, Kingsley, J. S., Laurie, M., Pocock, R. I., Stebbing, T. R. R.** Are the Arthropoda a Natural Group?—*Nat. Sci.*, X., 97 **Feb., 1897**

595.2 **Lankester, E. R.** Are the Arthropoda a Natural Group?—*Nat. Sci.*, X., 264 **April, 1897**

595.79 **Latter, O. H.** Wasps and Weismann.—*Nat. Sci.*, X., 47 **Jan., 1897**

597. **Collinge, W. E.** The Suprarenal Bodies of Fishes.—*Nat. Sci.*, X., 318 **May, 1897**

597. **Edinger, L.** Have Fish a Memory? A chapter in the Evolution of the Brain.—*Nat. Sci.*, X., 118 **Feb., 1897**

597.5 **Masterman, A. T.** Some Effects of Pelagic Spawning-habit on the Life-histories of Teleostean Fishes.—*Nat. Sci.*, X., 382 **June, 1897**

598.2(42) **Southwell, T.** The Migration of British Birds.—*Nat. Sci.*, X., 245 **April, 1897**

599.8 **Earle, C.** The Lemurs as Ancestors of the Apes.—*Nat. Sci.*, X., 309 **May, 1897**

599.9 **Buckman, S. S.** Human Evolution. II. According to Mr. G. Archdall Reid.—*Nat. Sci.*, X., 187 **March, 1897**

599.9 **Common, T.** Human Evolution. V. According to Nietzsche.—*Nat. Sci.*, X., 393 **June, 1897**

599.9 **Coste, F. H. P.** Human Evolution. I. According to Mr. H. G. Wells.—*Nat. Sci.*, X., 184 and 244 **March and April, 1897**

599.9 **Reid, G. A.**—Human Evolution. IV. Mr. Archdall Reid states his position.—*Nat. Sci.*, X., 305 **May, 1897**

599.9 **Wells, H. G.** Human Evolution. III. Mr. Wells Replies.—*Nat. Sci.*, X., 242 **April, 1897**

925. **Woodward, A. S.** Edward Drinker Cope.—*Nat. Sci.*, X., 377 **June, 1897**

SAVILE CLUB SMOKING ROOM

Vol. X. ALL RIGHTS RESERVED. No. 59.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

JANUARY, 1897.

CONTENTS.

PAGE

Notes and Comments 1
The little Trip of the "Fram"—The Value of Morphology—"A Plague o' both your Houses"—Alternation of Generations in Vertebrates—Wild Hybrids between the Arctic and Common Foxes—The Biology of the Great Lakes—A Star-fish "Struggle-for-Lifer"—An Eastern Question—A Revision of North-American Slugs—All Smoke and No Fire—The Antiquity of Man in Britain—Giant Ammonites—Had the Belemnite an Aptychus?—James Hall—The Eocene Beds of Dorset—Botanical Scraps from America.

I. Wanted, a British Fresh-water Biological Station. By D. J. Scourfield 17

II. The Position of Morphology in Zoological Science. By E. W. MacBride, B.A., B.Sc., Fellow of St. John's Coll., Cambridge .. 20

III. The Earliest Known Seat of Learning in Europe. By Professor A. C. Haddon, M.A., D.Sc., M.R.I.A. (Illustrated) 33

IV. Cope's "Factors of Evolution." By F. A. Bather, M.A., F.G.S. .. 37

V. Wasps and Weismann. By Oswald H. Latter, M.A. 47

Some New Books 50
Prehistoric Man and Beast: by H. N. Hutchinson (with Plate I.).—The Thirteenth Annual Report of the Bureau of Ethnology: by J. W. Powell (H. Balfour).—The Reliquary and Illustrated Archæologist: edited by J. R. Allen.—The Testimony of Science to the Deluge: by W. B. Galloway.—Stanford's Compendium of Geography and Travel: Africa; Vol. II., South Africa: by A. H. Keane.—Die Morphologie und Physiologie des Pflanzlichen Zellkernes: von A. Zimmerman (J. B. F.).—Catalogue of the Cases of Birds in the Dyke Road Museum, Brighton: by E. T. Booth.—Baran.—Varia.

Obituary 62
B. W. Richardson—D. Robertson—A. Dowsett—G. W. Child—T. King—W. F. Ainsworth—J. A. Moloney—J. W. Retgers—E. Wenzel—F. Westhoff—J. Feser—E. von Wolff—A. H. Post—E. Baumann.

News of Universities, Museums, and Societies 64

Correspondence 68
A. J. Jukes-Browne—A. B. Meyer—R. L. Jack—Wheelton Hind—W. F. Holroyd—H. Bolton.

LONDON: PAGE & PRATT, LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS, E.C.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent post-free for Annual Subscription of Thirteen Shillings.

N.B.!-For Price of Sets, see Special Note on p. 72.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	(*To all places Abroad*) Yearly	1 10 6
Half-Yearly	0 14 6	Half-Yearly	0 15 6
Quarterly	0 7 6	Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 edford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

Latest Publication of the Zoological Society of London.

The Zoological Record, Vol. XXXII. Being Records of Zoological Literature relating chiefly to the year 1895. Edited (for the Zoological Society of London) by D. SHARP, M.A., F.R.S., F.Z.S., etc. London, 1896. Price 30/-

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 4d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood.

WANTED.

The following numbers of NATURAL SCIENCE:

No. 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.

The Publishers are prepared to give half-a-crown apiece for clean copies of the above-named numbers until further notice.

Important Specimens for Museums, Universities, &c.

1. **TERTIARY MOLLUSCA** (British and Foreign), over 3,000 species
2. **TERTIARY BRYOZOA & EARTHS** (British and Foreign)
3. **FOSSIL FISHES** (Sets £10 to £50)
4. **COLOURED CASTS OF RARE FOSSILS**, including the remarkable skeleton of *Pareiasaurus Baini*, cranium and lower jaw of *Rhytina gigas*, *Dinornis maximus* (11 feet in height), &c., &c.

— *ADDRESS* —

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last five numbers of this Journal comprised the following specially contributed Articles:—

No. 55, September, 1896.

I. On English Amber and Amber Generally. Part II. By Professor H. Conwentz, Ph.D. (Illustrated.)

II. What shall we do with our Local Societies? By Professor G. S. Boulger, F.L.S., F.G.S.

III. A Zoologist in Tierra del Fuego: some Account of the Swedish Expedition, 1895–1896. By Axel Ohlin, Ph.D. (With 2 Maps, Plates III. and IV.)

IV. Casual Thoughts on Museums. Part V.—Anthropology. By Sir Henry Howorth, K.C.I.E., M.P., F.R.S.

V. The Structure of the Graptolites. Part I. By Dr. Carl Wiman. (Illustrated.)

VI. Zoology since Darwin. Part I. By Professor Ludwig von Graff, Ph.D.

No. 56, October, 1896.

I. The Arctic Work of 1896. By J. W. Gregory, D.Sc., F.G.S.

II. The Structure of the Graptolites. Part II. By Dr. Carl Wiman. (Illustrated.)

III. An Introduction to the Study of Anthropoid Apes. II.—The Chimpanzee. By Arthur Keith, M.D.

IV. The Organisation of Local Science. By George Abbott, M.R.C.S.

No. 57, November, 1896.

I. The Influence of Mind in Evolution. By EHA, Author of "A Naturalist on the Prowl."

II. The Preparation and Mounting of Chalk Fossils. By Arthur W. Rowe, M.D.

III. Zoology since Darwin. Part II. By Professor Ludwig von Graff, Ph.D.

IV. An Introduction to the Study of Anthropoid Apes. III.—The Orang-Outang. By Arthur Keith, M.D.

V. The Cell, and some of its Supposed Structures. By Professor J. Bretland Farmer, M.A.

No. 58, December, 1896.

I. The Determination of Fossils (with List of Specialists).

II. Zoology since Darwin. Part III. (conclusion). By Professor Ludwig von Graff, Ph.D.

III. A Plea for Details in Comparative Anatomy. By F. G. Parsons, M.D.

IV. An Introduction to the Study of Anthropoid Apes. IV.—The Gibbon. By Arthur Keith, M.D.

V. Cunning in Animals. By W. L. Calderwood, F.R.S.E.

One Shilling each Number, of any Bookseller.

Annual Subscription, payable in advance to PAGE & PRATT, Ltd. (successors to Rait, Henderson & Co., Ltd.), 22 St. Andrew Street, Holborn Circus, London, E.C., Thirteen Shillings ($3.50), post free.

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and insectivorous Plants (46 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection. histology, and museum purposes.
Many of these are splendidly preserved in Formalin.

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 24s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The NOVEMBER Number of Proceedings is now ready (Price 1s. 6d)

It contains REPORTS OF EXCURSIONS to the Crag District of Suffolk Reading, Hitchin, Potter's Bar, the new M. S. & L. Railway at Catesby (Northants) and between Nottingham and Leicester, and to West Somerset and North Devon; with several Plates and other Illustrations; also the Title-page, Index, &c., for Vol. XIV.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

Page & Pratt, Ltd.,

HAVING PURCHASED THE BUSINESS OF

RAIT, HENDERSON & CO., LIMITED,

Printers and Publishers,

Are prepared to undertake the Printing and Publishing of any . . .

MAGAZINES, BOOKS, AND JOURNALS

. . . required to be produced in the best style.

ESTIMATES ON APPLICATION.

22 St. Andrew St., Holborn Circus, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY PAGE & PRATT, LIMITED, SUCCESSORS TO RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. X. ALL RIGHTS RESERVED. No. 60.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

FEBRUARY, 1897.

CONTENTS.

PAGE

Notes and Comments 73

"—ologists" *versus* "Collectors"—The Scientific Arrangement of Insect Collections—The Kind of Work we Want—The Earthquake—Professor Bonney on Alpine Geology—Schistosity and Slaty Cleavage—The Classification of Precambrian Rocks—Telegony Again—The Function of the Intercostal Muscles—A New Giant-Bird—Monkeys in Madagascar—The Range of the Nummulite—Rank and Quality, and the Royal Society in 1778—Some American Botany—The Occurrence of Marine Organisms—The Problem of a Parasitic Copepod—The Hinge in Bivalve Molluscs—Species Manufacture.

I. Worked Flints from the Cromer Forest Bed. By W. J. Lewis Abbott, F.G.S. (Illustrated) 89

II. Are the Arthropoda a Natural Group? By Captain F. W. Hutton, F.R.S.; H. M. Bernard, M.A., F.L.S., F.Z.S.; G. H. Carpenter, B.Sc.; Hofrat Professor Carl Claus, Ph.D.; H. J. Hansen, Ph.D.; Professor Ritter A. von Jaworowski, Ph.D.; Professor J. S. Kingsley; Malcolm Laurie, M.A., F.L.S.; R. I. Pocock; Rev. T. R. R. Stebbing, M.A., F.R.S. (Illustrated) 97

III. Have Fish a Memory? A Chapter in the Evolution of the Brain. Abstracted from Professor Ludwig Edinger, Ph.D. 118

IV. Additions to our List of Palæontological Specialists 122

Some New Books 124

Catalogue of Madreporaria in British Museum, vol. ii.: by H. M. Bernard (G. C. Bourne).—Artistic and Scientific Taxidermy and Modelling: by Montagu Browne (W.P.P.).—Reproduction in Algæ and Fungi: by G. Klebs.—List of Vertebrated Animals in the Zoological Gardens, ninth edition: by P. L. Sclater.—New Serials.—Scraps from Serials.—Chivers' New Book List.

Obituary 133

E. Du Bois-Reymond—D. Robertson (T.R.R.S.)—T. G. E. Elger—J. A. Streng—E. D. Young, R.N.—V. de St. Martin—Dr. Strauss—A. Hénon—Captain Lucand—J. v. Gerlach—F. Benseler—L. Calori—R. Zoja—P. Binet—L. J. Sanford—F. Hazslinszky—A. Stadfeldt—F. Saccardo—A. Batalin—N. Dellingshausen—F. Morawitz—M. Galanin—H. Hale—W. H. Ross—H. J. Posselt—A. Negri—S. Scholz-Rogozinski.

News of Universities, Museums, and Societies 138

Correspondence 144

Rev. G. Henslow—J. D. F. Gilchrist.

LONDON: PAGE & PRATT, LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS, E.C.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent post-free for Annual Subscription of Thirteen Shillings.

N.B.!—For Price of Sets, see Special Note on p. iii. of cover.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.		£	s.	d.
Yearly	1	8	0	(*To all places Abroad*) Yearly	1	10	6
Half-Yearly	0	14	6	Half-Yearly	0	15	6
Quarterly	0	7	6	Quarterly	0	8	0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 4d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The NOVEMBER Number of Proceedings is now ready (Price 1s. 6d.)

It contains REPORTS OF EXCURSIONS to the Crag District of Suffolk Reading, Hitchin, Potter's Bar, the new M. S. & L. Railway at Catesby (Northants) and between Nottingham and Leicester, and to West Somerset and North Devon; with several Plates and other Illustrations; also the Title-page, Index, &c., for Vol. XIV.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last three numbers of this Journal comprised the following speciall contributed Articles:—

No. 57, November, 1896.

I. The Influence of Mind in Evolution. By EHA, Author of "A Naturalist on the Prowl."
II. The Preparation and Mounting of Chalk Fossils. By Arthur W. Rowe, M.D.
III. Zoology since Darwin. Part II. By Professor Ludwig von Graff, Ph D.
IV. An Introduction to the Study of Anthropoid Apes. III.—The Orang-Outang. By Arthur Keith, M.D.
V. The Cell, and some of its Supposed Structures. By Professor J. Bretland Farmer, M.A.

No. 58, December, 1896.

I. The Determination of Fossils (with List of Specialists).
II. Zoology since Darwin. Part III. (conclusion). By Professor Ludwig von Graff, Ph.D.
III. A Plea for Details in Comparative Anatomy. By F. G. Parsons, M.D.
IV. An Introduction to the Study of Anthropoid Apes. IV.—The Gibbon. By Arthur Keith, M.D.
V. Cunning in Animals. By W. L. Calderwood, F.R.S.E.

No. 59, January, 1897.

I. Wanted. a British Fresh-water Biological Station. By D. J. Scourfield.
II. The Position of Morphology in Zoological Science. By E. W. MacBride, B.A., B.Sc., Fellow of St. John's College, Cambridge.
III. The Earliest Known Seat of Learning in Europe. By Professor A. C. Haddon, M.A., D.Sc., M.R.I.A. (Illustrated).
IV. Cope's "Factors of Evolution." By F. A. Bather, M.A., F.G.S.
V. Wasps and Weismann. By Oswald H. Latter, M.A.

One Shilling each Number, of any Bookseller.

Annual Subscription, payable in advance to PAGE & PRATT, Ltd. (successors to Rait, Henderson & Co., Ltd.), 22 St. Andrew Street, Holborn Circus, London, E.C., Thirteen Shillings ($3.50), post free.

Price of set of Vols. I., II., III., IV. £2 0 0
" " " *V., VI., VII., VIII.* £1 4 0
" " " *I.–VIII.* £3 0 0

It will shortly be necessary to RAISE *the price of Vols. I.–IV. still further.*

NATURAL SCIENCE REPRINTS.

Under this heading there will be published on February 1, a Limited Number of Reprints of the valuable series of Articles—

AN INTRODUCTION TO THE STUDY OF

ANTHROPOID APES

BY ARTHUR KEITH, M.D.

Forming an Octavo of 48 pages, same size as NATURAL SCIENCE, *in stiff paper cover:*

PRICE TWO SHILLINGS NETT.

This forms a complete guide to the literature of the subject, with critical comments and suggestions for future investigators; indispensable to students.

Orders are now being received by

PAGE & PRATT, Ltd., 22 St. Andrew Street, London, E.C.

Botany and Marine Zoology.

SPECIALITIES.

1. **LANTERN SLIDES** for lectures and demonstrations at 9/- per doz.; on Hire at 2/- per doz. Many photos from Nature—20 extensive sets now complete. The sets illustrative of *Evolution* (200 slides), *Mimicry* (40 slides), *Pond-Life* (56 slides), *Anemones and Coral Reefs* (50 slides), *Fertilization of Flowers* (60 slides), *Plant Histology* (Photomicrographs) are especially fine, and, in certain respects, unique.

2. **MICROSCOPICAL SLIDES,** in Botany and Marine Zoology, specially prepared for teaching purposes—quality guaranteed perfect. Price from 5/- per doz. *Plankton mounts and sections of flower- and leaf-buds are specialities.*

3. 500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes. *Special attention is given to the preparation and supply of Scyllium*—perfect quality, 8/- per doz.

4. Disarticulated **OSTEOLOGICAL PREPARATIONS,** mounted on *polished* mahogany or ebonite boards, special processes, &c., distinctively marked, with index. The following are merely representative examples:—Wing of Bird, 6/- to 7/-; Limb of Dog, 7/-; of Rabbit, 5/6; of Dolphin, 10/6; of Monkey, 7/6 to 10/6. **SPECIAL**:—Complete Disarticulated Skeleton of **FROG,** fully indexed, 10/6—very fine preparation. Also Articulated Skeleton of *Scyllium*, in tall museum jar, 25/- complete.

CATALOGUES FREE ON APPLICATION.

JAS. HORNELL, Biological Station, JERSEY.

Important Specimens for Museums, Universities, &c.

1. **TERTIARY MOLLUSCA** (British and Foreign), over 3,000 species
2. **TERTIARY BRYOZOA & EARTHS** (British and Foreign)
3. **FOSSIL FISHES** (Sets £10 to £50)
4. **COLOURED CASTS OF RARE FOSSILS,** including the remarkable skeleton of *Pareiasaurus Baini*, cranium and lower jaw of *Rhytina gigas*, *Dinornis maximus* (11 feet in height), &c., &c.

— *ADDRESS* —

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

Page & Pratt, Ltd.,

HAVING PURCHASED THE BUSINESS OF

RAIT, HENDERSON & CO., LIMITED,

Printers and Publishers,

Are prepared to undertake the Printing and Publishing of any . . .

MAGAZINES, BOOKS, AND JOURNALS

. . . required to be produced in the best style.

ESTIMATES ON APPLICATION.

22 St. Andrew St., Holborn Circus, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY PAGE & PRATT, LIMITED, SUCCESSORS TO RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. X. ALL RIGHTS RESERVED. No. 61.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

MARCH, 1897.

CONTENTS.

PAGE

Notes and Comments 145
Franz Josef Land and its Explorers—The Learned Society Bore—Sir Henry Howorth—The Organisation of Science in the United States—Geographical Distribution in America—A Remarkable Rodent—Palæontological Peccadilloes—Strata as Diagnostic of Species—The Meaning of a Species—A Pine and its Fungus—Drunk and Incapable—East African Lepidoptera—The Great Carcinologist of Norway—An Ancient Arachnid—Prehistoric Man—Has the Lamprey a Supra-Renal Body?—Sergestes—The Eggs of the Nautilus—Evidence for the South African Committee.

I. The Problem of Instinct. By Alfred Russel Wallace, D.C.L., F.R.S. 161

II. Fresh-water Biological Stations: Europe's Example. By Professor Anton Fritsch, Ph.D. (Illustrated) 169

III. The Light-Sensations of Eyeless Animals. By H. M. Bernard, M.A., F.L.S., F.Z.S. 173

IV. The Literature of Fossil Ostracods. By C. Davies Sherborn, F.G.S., F.Z.S. 181

V. Human Evolution. I.—According to Mr. H. G. Wells. By F. H. Perry Coste, B.Sc., F.L.S. II.—According to Mr. G. Archdall Reid. By S. S. Buckman, F.G.S. 184

VI. Science in New Zealand 192

Some New Books 194
The Cambridge Natural History, vol. II.: edited by S. F. Harmer and A. E. Shipley (Illustrated).—Neue Versuche zum Saison-Dimorphismus der Schmetterlinge; New Experiments on the Seasonal Dimorphism of Lepidoptera: by A. Weismann.—The Natural History of *Eristalis Tenax*: by G. B. Buckton.—The Survival of the Unlike: by L. H. Bailey (George Henslow).—Thomas Say as Palæontologist.—New Serials.—Bibliography.—Scraps from Serials.

Obituary 208
H. Gätke (J. Cordeaux)—S. Wells—H. Boswell—E. Ballard—R. Warner—J. Chappell—E. Moreau—P. Briard—G. F. Schacht—H. von Nördlinger—E. Dallman—T. J. Lickfett—F. von Baur—A. Dürrnberger—R. Raimann—J. Ullepitsch—F. Kraus—A. L. Brot—S. Trinchese—E. de Betta—J. H. Thiry—A. A. van Bemmelen—S. A. B. Lundgren—C. Bahnson—C. Heitzmann—W. H. Pancoast—W. H. Ward—E. G. Lodeman.

News of Universities, Museums, and Societies 210

Correspondence 214
A. Montefiore Brice.

LONDON: PAGE & PRATT, LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS, E.C.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent post-free for Annual Subscription of Thirteen Shillings.

N.B.!—For Price of Sets, see Special Note on p. iii. of cover.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	*(To all places Abroad)*	
Half-Yearly	0 14 6	Yearly	1 10 6
Quarterly	0 7 6	Half-Yearly	0 15 6
		Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 4d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood.

FOR SALE, Vols. I.–IX. of NATURAL SCIENCE, in perfect condition. Vols. I.–III. half-calf, the rest unbound. What offers?—T. STEPHENSON, Burnham, Somerset.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The NOVEMBER Number of Proceedings is now ready (Price 1s. 6d.)

It contains REPORTS OF EXCURSIONS to the Crag District of Suffolk, Reading, Hitchin, Potter's Bar, the new M. S. & L. Railway at Catesby (Northants) and between Nottingham and Leicester, and to West Somerset and North Devon; with several Plates and other Illustrations; also the Title-page, Index, &c., for Vol. XIV.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last two numbers of this Journal comprised the following specially contributed Articles:—

No. 59, January, 1897.

I. Wanted, a British Fresh-water Biological Station. By D. J. Scourfield.
II. The Position of Morphology in Zoological Science. By E. W. MacBride, B.A., B.Sc., Fellow of St. John's College, Cambridge.
III. The Earliest Known Seat of Learning in Europe. By Professor A. C. Haddon, M.A., D.Sc., M.R.I.A. (Illustrated).
IV. Cope's "Factors of Evolution." By F. A. Bather, M.A., F.G.S.
V. Wasps and Weismann. By Oswald H. Latter, M.A.

No. 60, February, 1897.

I. Worked Flints from the Cromer Forest Bed. By W. J. Lewis Abbott, F.G.S. (Illustrated.)
II. Are the Arthropoda a Natural Group? By Captain F. W. Hutton, F.R.S.; H. M. Bernard, M.A., F.L.S., F.Z.S.; G. H. Carpenter, B.Sc.; Hofrat Professor Carl Claus, Ph.D.; H. J. Hansen, Ph.D.; Professor Ritter A. von Jaworowski, Ph.D.; Professor J. S. Kingsley; Malcolm Laurie, M.A., F.L.S.; R. I. Pocock; Rev. T. R. R. Stebbing, M.A., F.R.S. (Illustrated.)
III. Have Fish a Memory? A Chapter in the Evolution of the Brain. Abstracted from Professor Ludwig Edinger, Ph.D.
IV. Additions to our List of Palæontological Specialists.

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22 St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

To our Subscribers and Others.—*There are now published* Nine Volumes of Natural Science. *Nos.* 1, 8, 11, 12, 13, 20, 23 *and* 24 *being* out of print, *can only be supplied in the set of first Four Volumes. All other Nos. can still be supplied at* One Shilling *each.*

Price of set of Vols. I., II., III., IV.	£2	10 0
" " " *V., VI., VII., VIII.*	£1	4 0
" " " *I.–VIII.*	£3	10 0

One Shilling each Number, of any Bookseller.

Annual Subscription, payable in advance to PAGE & PRATT, Ltd. (successors to Rait, Henderson & Co., Ltd.), 22 St. Andrew Street, Holborn Circus, London, E.C., Thirteen Shillings ($3.50), post free.

NATURAL SCIENCE REPRINTS.

NOW READY, a Limited Number of Reprints of the valuable series of Articles—

AN INTRODUCTION TO THE STUDY OF

ANTHROPOID APES

By ARTHUR KEITH, M.D.

With Preface and Corrections by the Author, and a letter from Dr. A. B. Meyer. Forming an Octavo of 48 *pages, same size as* Natural Science, *in stiff paper cover:*

PRICE TWO SHILLINGS NETT.

This forms a complete guide to the literature of the subject, with critical comments and suggestions for future investigators; indispensable to students.

Orders are now being received by

PAGE & PRATT, Ltd., 22 St. Andrew Street, London, E.C.

Botany and Marine Zoology.

SPECIALITIES.

1. **LANTERN SLIDES** for lectures and demonstrations at 9/- per doz.; on Hire at 2/- per doz. Many photos from Nature—20 extensive sets now complete. The sets illustrative of *Evolution* (200 slides), *Mimicry* (40 slides), *Pond-Life* (56 slides), *Anemones and Coral Reefs* (50 slides), *Fertilization of Flowers* (60 slides), *Plant Histology* (Photomicrographs) are especially fine, and, in certain respects, unique.

2. **MICROSCOPICAL SLIDES,** in Botany and Marine Zoology, specially prepared for teaching purposes—quality guaranteed perfect. Price from 5/- per doz. *Plankton mounts and sections of flower- and leaf-buds are specialities.*

3. 500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes. *Special attention is given to the preparation and supply of Scyllium*—perfect quality, 8/- per doz.

4. Disarticulated **OSTEOLOGICAL PREPARATIONS,** mounted on *polished* mahogany or ebonite boards, special processes, &c., distinctively marked, with index. The following are merely representative examples:—Wing of Bird, 6/- to 7/-; Limb of Dog, 7/-; of Rabbit, 5/6; of Dolphin, 10/6; of Monkey, 7/6 to 10/6. **SPECIAL:**—Complete Disarticulated Skeleton of **FROG,** fully indexed, 10/6—very fine preparation. Also Articulated Skeleton of *Scyllium*, in tall museum jar, 25/- complete.

CATALOGUES FREE ON APPLICATION.

JAS. HORNELL, Biological Station, JERSEY.

Important Specimens for Museums, Universities, &c.

1. **TERTIARY MOLLUSCA** (British and Foreign), over 3,000 species
2. **TERTIARY BRYOZOA & EARTHS** (British and Foreign)
3. **FOSSIL FISHES** (Sets £10 to £50)
4. **COLOURED CASTS OF RARE FOSSILS,** including the remarkable skeleton of *Pareiasaurus Baini*, cranium and lower jaw of *Rhytina gigas*, *Elasmotherium Fischeri*, and of *Dinornis maximus* (11 feet in height), &c., &c.

N.B.—Last new cast, *Lariosaurus Balsami.*

— *ADDRESS* —

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

Page & Pratt, Ltd.,

HAVING PURCHASED THE BUSINESS OF

RAIT, HENDERSON & CO., LIMITED,

Printers and Publishers,

Are prepared to undertake the Printing and Publishing of any . . .

MAGAZINES, BOOKS, AND JOURNALS

. . . required to be produced in the best style.

ESTIMATES ON APPLICATION.

22 St. Andrew St., Holborn Circus, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY PAGE & PRATT, LIMITED, SUCCESSORS TO RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. X. ALL RIGHTS RESERVED. No. 62.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

APRIL, 1897.

CONTENTS.

PAGE

Notes and Comments 217
The Modern Scientific (?) Explorer—A "Dunciad" of Zoology—Menelik's Library—The Shell-ornaments of the Mas d' Azil Scholars—The Royal Botanic Gardens—The Registration of Plants—The Dispersal of Seeds—The Horniman Museum (Illustrated)—A Species-monger on New Zealand Midges—Insect Enemies of Domestic Animals—The Scientific Publications of the American Government—The U.S. Department of Agriculture—Funafuti—Artesian Water—Differentiation in Rock-magmas—Modern Crystal-gazing—North American Oligochaetes—The Literary and Philosophical Society of Newcastle-on-Tyne.

I. On the Discovery of Chipped Flint-flakes in the Pliocene of Burma. By Fritz Noetling, Ph.D., of the Geological Survey of India. (Illustrated) 233

II. Human Evolution. III.—Mr. Wells Replies. By H. G. Wells, B.Sc. With a Note by F. H. Perry Coste, B.Sc., F.L.S. 242

III. The Migration of British Birds. By Thomas Southwell, F.Z.S., M.B.O.U. 245

IV. The Horn Expedition to Central Australia 254

V. Are the Arthropoda a Natural Group? By Professor E. Ray Lankester, M.A., LL.D., V.-P.R.S. 264

Some New Books 269
Farthest North: by Fridtjof Nansen.—Catalogue of Welwitsch's African Plants: by W. P. Hiern.—Manual and Dictionary of Flowering Plants and Ferns: by J. C. Willis.—Kirkes' Handbook of Physiology: edited by W. D. Halliburton.—Scraps from Serials.—New Serials.—To our French and German Colleagues!

Obituary 280
C. E. Bendire—Constantin, Baron Ettingshausen—W. Wilson—G. T. Thomassen—F. I. Warner—C. Contejean—E. Saubinet—C. F. Wiepken—A. Rogerhofer—N. Zdekauer—A. Cecchi—A. Pirona—P. Taubert—J. D. Weeks—W. H. Ward—H. L. Whiting.

News of Universities, Museums, and Societies 282

Correspondence 286
Mr. Jackson's Map of Franz Josef Land: A. Montefiore Brice. With Plate II. (folding coloured Map).

LONDON: PAGE & PRATT, LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS, E.C.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent post-free for Annual Subscription of Thirteen Shillings.

N.B.!—For Price of Sets, see Special Note on p. iii. of cover.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	*(To all places Abroad)* **Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up. — GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 6d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The FEBRUARY Number of Proceedings is now ready (Price 1s. 6d.)

It contains "AN OUTLINE OF THE PETROLOGY AND PHYSICAL HISTORY OF THE ALPS." By Prof. T. G. Bonney, D.Sc., LL.D., F.R.S. Illustrated by a diagrammatic Section of the Alps; and "THE FORAMINIFERA OF THE THANET BEDS OF PEGWELL BAY." With notes on other Microscopic Organisms; a description of the Section at Pegwell Bay; and remarks on the Correlation of the Thanet Beds. By Henry W. Burrows, A.R.I.B.A., and Richard Holland. Illustrated by Horizontal and Vertical Sections.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last number of this Journal comprised the following specially contributed Articles:—

No. 61, March, 1897.

I. The Problem of Instinct. By Alfred Russel Wallace, D.C.L., F.R.S.
II. Fresh-water Biological Stations: Europe's Example. By Professor Anton Fritsch, Ph.D. (Illustrated.)
III. The Light-Sensations of Eyeless Animals. By H. M. Bernard, M.A., F.L.S., F.Z.S.
IV. The Literature of Fossil Ostracods. By C. Davies Sherborn, F.G.S., F.Z.S.
V. Human Evolution. I.—According to Mr. H. G. Wells. By F. H. Perry Coste, B.Sc., F.L.S. II.—According to Mr. G. Archdall Reid. By S. S. Buckman, F.G.S.
VI. Science in New Zealand.

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22 St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

To our Subscribers and Others.—*There are now published* Nine Volumes of Natural Science. *Nos.* 1, 8, 11, 12, 13, 20, 23 *and* 24 *being* out of print, *can only be supplied in the set of first Four Volumes. All other Nos. can still be supplied at* One Shilling *each.*

Price of set of Vols. I., II., III., IV.	£2	10 0
„ „ „ *V., VI., VII., VIII.*	£1	4 0
„ „ „ *I.–VIII.*	£3	10 0

One Shilling each Number, of any Bookseller.

Annual Subscription, payable in advance to PAGE & PRATT, Ltd. (successors to Rait, Henderson & Co., Ltd.), 22 St. Andrew Street, Holborn Circus, London, E.C., Thirteen Shillings ($3.50), post free.

WANTED.—*The following numbers of* Natural Science:—*No.* 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.

The Publishers are prepared to give **Four Shillings** *each for clean copies of No.* 8, *and* 2/6 *each for the other numbers named above, until further notice.*

NATURAL SCIENCE REPRINTS.

NOW READY, a Limited Number of Reprints of the valuable series of Articles—

AN INTRODUCTION TO THE STUDY OF

ANTHROPOID APES

By ARTHUR KEITH, M.D.

With Preface and Corrections by the Author, and a letter from Dr. A. B. Meyer. Forming an Octavo of 48 *pages, same size as* Natural Science, *in stiff paper cover:*

PRICE TWO SHILLINGS NETT.

This forms a complete guide to the literature of the subject, with critical comments and suggestions for future investigators; indispensable to students.

Orders are now being received by

PAGE & PRATT, Ltd., 22 St. Andrew Street, London, E.C.

Botany and Marine Zoology.

SPECIALITIES.

1. **LANTERN SLIDES** for lectures and demonstrations at 9/- per doz.; on Hire at 2/- per doz. Many photos from Nature—20 extensive sets now complete. The sets illustrative of *Evolution* (200 slides). *Mimicry* (40 slides), *Pond-Life* (56 slides). *Anemones and Coral Reefs* (50 slides). *Fertilization of Flowers* (60 slides), *Plant Histology* (Photomicrographs) are especially fine, and, in certain respects, unique.

2. **MICROSCOPICAL SLIDES,** in Botany and Marine Zoology, specially prepared for teaching purposes—quality guaranteed perfect. Price from 5/- per doz. *Plankton mounts and sections of flower- and leaf-buds are specialities.*

3. 500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes. *Special attention is given to the preparation and supply of Scyllium*—perfect quality, 8/- per doz.

4. Disarticulated **OSTEOLOGICAL PREPARATIONS,** mounted on *polished* mahogany or ebonite boards, special processes, &c., distinctively marked, with index. The following are merely representative examples:—Wing of Bird, 6/- to 7/-; Limb of Dog, 7/-; of Rabbit, 5/6; of Dolphin, 10/6; of Monkey, 7/6 to 10/6. **SPECIAL**:—Complete Disarticulated Skeleton of **FROG,** fully indexed, 10/6—very fine preparation. Also Articulated Skeleton of *Scyllium*, in tall museum jar, 25/- complete.

CATALOGUES FREE ON APPLICATION.

JAS. HORNELL, Biological Station, JERSEY.

Important Specimens for Museums, Universities, &c.

1. **TERTIARY MOLLUSCA** (British and Foreign), over 3,000 species
2. **TERTIARY BRYOZOA & EARTHS** (British and Foreign)
3. **FOSSIL FISHES** (Sets £10 to £50)
4. **COLOURED CASTS OF RARE FOSSILS,** including the remarkable skeleton of *Pareiasaurus Baini*, cranium and lower jaw of *Rhytina gigas*, and of *Elasmotherium Fischeri*; also mounted model skeleton of *Dinornis maximus* (11 feet in height), &c., &c.

N.B.—Last new cast, *Lariosaurus Balsami.*

— *ADDRESS* —

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

Page & Pratt, Ltd.,

HAVING PURCHASED THE BUSINESS OF

RAIT, HENDERSON & CO., LIMITED,

Printers and Publishers,

Are prepared to undertake the Printing and Publishing of any . . .

MAGAZINES, BOOKS, AND JOURNALS

. . . required to be produced in the best style.

ESTIMATES ON APPLICATION

22 St. Andrew St., Holborn Circus, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY PAGE & PRATT, LIMITED, SUCCESSORS TO RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. X.
ALL RIGHTS RESERVED.
No. 63.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

MAY, 1897.

CONTENTS.

PAGE

Notes and Comments 289

The Case of the Chemical Society—The Army Examinations and Science in Public Schools—Young Oxford and Science—Supposed Remarkable Sea-anemones—Zoology at Bergen—The eyes in Pecten and Lima—Archaeology at Bergen—Formol for Zoological Specimens—The Preservation of Fish and Reptiles—How are Crustacea to be Preserved?—The Fixation of Soft-bodied Marine Invertebrates—Preservation of Vertebrate Tissues—Fever in Plants—Bulb-Growing—The Antiquity of Man in the Eastern United States—The extinction of British Butterflies—The Extermination of the Golden Eagle—Buffaloes.

I. Human Evolution. IV.—By G. Archdall Reid, M.B. 305

II. The Lemurs as Ancestors of the Apes. By Charles Earle .. 309

III. The Museums of Public Schools. III.—Rugby, By L. Cumming, M.A. (with Plate III.) 314

IV. The Suprarenal Bodies of Fishes. By Walter E. Collinge, F.Z.S. 318

V. Numerical Variation of Parts in Ranunculus repens. By John H. Pledge. (with Four Charts) 323

Some New Books 329

Lepidoptera of the British Islands: by C. G. Barrett; Handbook to the Order Lepidoptera, vols III. and IV: by W. F. Kirby; Monograph of the Bombycine Moths of America; Notodontidæ: by A. S. Packard (G. H. Carpenter).—Mechanical Selection: by K. Jordan, (G. H. Carpenter).—Hemiptera Homoptera of the British Islands: by J. Edwards.—Oceanic Ichthyology: by G. Brown Goode and T. H. Bean.—Marketable Marine Fishes of the British Isles: by J. T. Cunningham.—Botanisches Practicum: by E. Strasburger (D.H.S.)—Manual of Determinative Mineralogy: by G. J. Brush (G.T.P.)—Gemmographical Tables: by W. J. Lewis Abbott.—Lehrbuch der Vergleichenden Anatomie der Wirbeltiere, I. Der Magen: by A. Oppel.—Catalogus Mammalium: by E. L. Trouessart, (O.T.)—Catalogue des Bibliographies Geologiques: by E. de Margerie.—Bibliographies.—Willesden.—Scraps from Serials.—New Serials.

Obituary 353

E. D. Cope—Dr. Kenngott—L. N. Johnson—G. Ville—J. Kořstál R. Hogg.

News of Universities, Museums, and Societies 354

Correspondence 357

G. F. Dollfus—E. S. Goodrich—P. Q. Keegan—W. K. Brooks—T. D. A. Cockerell.

LONDON: PAGE & PRATT, LTD,
22 ST. ANDREW STREET, HOLBORN CIRCUS, E.C.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent post-free for Annual Subscription of Thirteen Shillings.

N.B.!—For Price of Sets, see Special Note on p. 360.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.		£	s.	d.
Yearly	1	8	0	*(To all places Abroad)* **Yearly**	1	10	6
Half-Yearly	0	14	6	**Half-Yearly**	0	15	6
Quarterly	0	7	6	**Quarterly**	0	8	0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6 6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up. — GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 6d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood

CHANGE OF ADDRESS.

On the completion of this Volume, which ends with the June number, the Publishing and Editorial Offices of

NATURAL SCIENCE

Will be TRANSFERRED to

Messrs. J. M. DENT & CO.,

67 St. JAMES'S STREET, LONDON, S.W.

Who are now prepared to receive orders for Volume XI.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last number of this Journal comprised the following specially contributed Articles:—

No. 62, April, 1897.

I. On the Discovery of Chipped Flint-Flakes in the Pliocene of Burma. By Fritz Noetling, Ph.D., of the Geological Survey of India. (Illustrated.)
II. Human Evolution. III.—Mr. Wells Replies. By H. G. Wells, B.Sc. With a Note by F. H. Perry Coste, B.Sc., F.L.S.
III. The Migration of British Birds. By Thomas Southwell, F.Z.S., M.B.O.U.
IV. The Horn Expedition to Central Australia.
V. Are the Arthropoda a Natural Group? By Professor E. Ray Lankester, M.A., LL.D., V.-P.R.S.

One Shilling each Number, of any Bookseller.

Annual Subscription, payable in advance to PAGE & PRATT, Ltd. (successors to Rait, Henderson & Co., Ltd.), 22 St. Andrew Street, Holborn Circus, London, E.C., Thirteen Shillings ($3.50), post free.

WANTED.—*The following numbers of* NATURAL SCIENCE:—*No.* 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.
The Publishers are prepared to give **Four Shillings** *each for clean copies of No.* 8, *and* 2/6 *each for the other numbers named above, until further notice.*

NATURAL SCIENCE REPRINTS.

NOW READY, a Limited Number of Reprints of the valuable series of Articles—

AN INTRODUCTION TO THE STUDY OF

ANTHROPOID APES

By ARTHUR KEITH, M.D.

With Preface and Corrections by the Author, and a letter from Dr. A. B. Meyer. Forming an Octavo of 48 *pages, same size as* NATURAL SCIENCE, *in stiff paper cover:*

PRICE TWO SHILLINGS NETT.

This forms a complete guide to the literature of the subject, with critical comments and suggestions for future investigators; indispensable to students.

Orders are now being received by

PAGE & PRATT, Ltd., 22 St. Andrew Street, London, E.C.

Zoological Society of London.

A Course of Ten Popular Lectures on Birds will be delivered in the Lecture-room in the Society's Gardens, Regent's Park, on Thursdays, at 5 p.m., commencing May 6th, by Mr. F. E. BEDDARD, M.A., F.R.S., Prosector to the Society.

Tickets for the whole Course (including entrance to the Gardens) 10s. each, or 1s. each lecture (not including entrance), to be obtained at the Society's Office,

3 HANOVER SQUARE, W.

(Fellows admitted free).

Government of Western Australia.

APPLICATIONS are invited for the position of **ASSISTANT GEOLOGIST** at a Salary of £300 per annum and actual travelling and incidental expenses incurred.

The Applications, accompanied by testimonials (copies in the first instance), and an account of the candidate's experience in Geology and Mining, to be lodged with the undersigned not later than the 30th of June, 1897.

HENRY C. PRINSEP,
Under-Secretary for Mines.

Department of Mines,
Perth, W.A.
24th February, 1897.

Botany and Marine Zoology.

SPECIALITIES.

LANTERN SLIDES for lectures and demonstrations at 9/- per doz.; on Hire at 2/- per doz. Many photos from Nature—20 extensive sets now complete. The sets illustrative of *Evolution* (200 slides). *Mimicry* (40 slides). *Pond-Life* (56 slides). *Anemones and Coral Reefs* (50 slides). *Fertilization of Flowers* (60 slides). *Plant Histology* (Photomicrographs) are especially fine, and, in certain respects, unique.

MICROSCOPICAL SLIDES, in Botany and Marine Zoology, specially prepared for teaching purposes—quality guaranteed perfect. Price from 5/- per doz. *Plankton mounts and sections of flower- and leaf-buds are specialities.*

3. 500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes. *Special attention is given to the preparation and supply of Scyllium*—perfect quality, 8/- per doz.

4. Disarticulated **OSTEOLOGICAL PREPARATIONS,** mounted on *polished* mahogany or ebonite boards, special processes, &c., distinctively marked, with index. The following are merely representative examples:—Wing of Bird, 6/- to 7/-; Limb of Dog, 7/-; of Rabbit, 5/6; of Dolphin, 10/6; of Monkey, 7/6 to 10/6. **SPECIAL:**—Complete Disarticulated Skeleton of **FROG,** fully indexed, 10/6—very fine preparation. Also Articulated Skeleton of *Scyllium*, in tall museum jar, 25/- complete.

CATALOGUES FREE ON APPLICATION.

JAS. HORNELL, Biological Station, JERSEY.

Important Specimens for Museums, Universities, &c.

1. **TERTIARY MOLLUSCA** (British and Foreign), over 3,000 species
2. **TERTIARY BRYOZOA & EARTHS** (British and Foreign)
3. **FOSSIL FISHES** (Sets £10 to £50)
4. **COLOURED CASTS OF RARE FOSSILS,** including the remarkable skeleton of *Pareiasaurus Baini*, cranium and lower jaw of *Rhytina gigas*, and of *Elasmotherium Fischeri*; also mounted model skeleton of *Dinornis maximus* (11 feet in height), &c., &c.

N.B.—Last new cast, *Lariosaurus Balsami.*

— *ADDRESS* —

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

Page & Pratt, Ltd.,

HAVING PURCHASED THE BUSINESS OF

RAIT, HENDERSON & CO., LIMITED,

Printers and Publishers,

Are prepared to undertake the Printing and Publishing of any . . .

MAGAZINES, BOOKS, AND JOURNALS

. . . required to be produced in the best style.

ESTIMATES ON APPLICATION

22 St. Andrew St., Holborn Circus, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY PAGE & PRATT, LIMITED, SUCCESSORS TO RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. X.
ALL RIGHTS RESERVED.
No. 64.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

JUNE, 1897.

CONTENTS.

PAGE

Notes and Comments 361
Change of Address—The Scientific Method in Education—An Appeal to the Teachers—The Educational Value of Botany and Physiology—The Illinois Fresh-water Biological Station—"Pump Plankton"—The Classification of Rodents—"Guts and Other Charnel-house Stuff"—The Hoatzin—The "Index Animalium"—The Dutch Scientific and Medical Congress—Publication by the U.S. Department of Agriculture—Civilisation in the United States Congress—Theoretical Darwinism—Colour Variation in Flowers—Boulder Clay, a Marine Deposit—An Old Zoological Record and Address Book—The Falsification of the Record—To the Humanitarian League

I. Edward Drinker Cope. By A. Smith Woodward, F.L.S., F.G.S., F.Z.S. (with Plate IV.) 377

II. Some Effects of the Pelagic Spawning-habit on the Life-histories of Teleostean Fishes. By Arthur T. Masterman, B.A., B.Sc. (Illustrated.) 382

III. Human Evolution. V. According to Nietzsche. By Thomas Common 393

IV. The Genealogy of the Sciences as the Basis of their Bibliography. By Henryk Arctowski, of the Belgian Antarctic Expedition 395

V. The Facts of Chromosome-reduction *versus* the Postulates of Weismann. By J. E. S. Moore, A.R.C.S. (Illustrated.) 401

VI. Oscar Hertwig on Mechanics and Biology. By L. J. Veley 411

Some New Books 415
Dictionary of Birds, Pt. IV.: by A. Newton (W. P. Pycraft).—Schmetterlingsfauna von Hildesheim, I. Tagfalter: by A. R. Grote (G. H. C.)—Analytic Keys to the Genera and Species of North American Mosses: by C. R. Barnes and F. D. Heald (A.G.).—New Charter: edited by H. S. Salt.—La Pisciculture Marine: by M. Baudouin.—Northumberland Sea Fisheries Committee: by A. Meek.—Chronographe Géologique: by E. Renevier.—Glastonbury Lake-village.—Scraps from Serials. New Serials.

Obituary 422
A. D. Bartlett.—E. Newton.—M. Sintenis.—F. Tognini.—L. Kärnbach.—M. Thollon.—A. Palumbo.—J. B. Barla.—Professor Berthaud.—G. Gercke.

News of Universities, Museums, and Societies 423

Correspondence 429
J. A. Wanklyn—J. H. Pledge—F. Buchanan—T. Southwell—G. H. Carpenter.

Title-page, Index, and Subject-Index.

LONDON: PAGE & PRATT, LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS, E.C.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent post-free for Annual Subscription of Thirteen Shillings.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		(*To all places Abroad*) £ s. d.
Yearly	1 8 0	**Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. R. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists.

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

Latest Publications of the Zoological Society of London.

Proceedings of the Zoological Society of London, Part IV., containing papers read at the Scientific Meetings held in November and Decembe 1896, with Sixteen Plates. Price to Fellows 9/-; to the Public, 12/-.

Transactions, Vol. XIV., Part III., containing the following papers:—"The Suprarenal Bodies in Fishes, and their relation to the so-called Head-Kidney," by Swale Vincent, M.B., Lond.; with Six Plates. "A Supplementary Report on the Crustaceans of the Group *Myelocopa*, obtained during the "Challenger" Expedition, with notes on other new or imperfectly known species." By G. Stewardson Brady, M.D., LL.D., F.R.S., with Three Plates. Price to Fellows, 15/9; to the Public, 21/-.

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

CHANGE OF ADDRESS.

On the completion of this Volume, which ends with the June number, the Publishing and Editorial Offices of

NATURAL SCIENCE

Will be TRANSFERRED to

Messrs. J. M. DENT & CO.,

67 St. JAMES'S STREET, LONDON, S.W.

Who are now prepared to receive orders for Volume XI.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last three numbers of this Journal comprised the following specially contributed Articles:—

No. 63, May, 1897.

I. Human Evolution. IV.—By G. Archdall Reid, M.B.
II. The Lemurs as Ancestors of the Apes. By Charles Earle.
III. The Museums of Public Schools. III.—Rugby. By L. Cumming, M.A. (with Plate III.)
IV. The Suprarenal Bodies of Fishes. By Walter E. Collinge, F.Z.S.
V. Numerical Variation of Parts in Ranunculus repens. By John H. Pledge (with four charts.)

One Shilling each Number, of any Bookseller.

Annual Subscription, payable in advance to J. M. DENT & CO., 67 St. James's Street, London, S.W., Thirteen Shillings ($3.50), post free.

WANTED.—*The following numbers of* NATURAL SCIENCE:—*No.* 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.

The Publishers are prepared to give **Four Shillings** *each for clean copies of No.* 8, *and* 2/6 *each for the other numbers named above, until further notice.*

NATURAL SCIENCE REPRINTS.

NOW READY, a Limited Number of Reprints of the valuable series of Articles—

AN INTRODUCTION TO THE STUDY OF

ANTHROPOID APES

By ARTHUR KEITH, M.D.

With Preface and Corrections by the Author, and a letter from Dr. A. B. Meyer. Forming an Octavo of 48 *pages, same size as* NATURAL SCIENCE, *in stiff paper cover:*

PRICE TWO SHILLINGS NETT.

This forms a complete guide to the literature of the subject, with critical comments and suggestions for future investigators; indispensable to students.

Orders are now being received by

PAGE & PRATT, Ltd., 22 St. Andrew Street, London, E.C.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The MAY Number of Proceedings is now ready (Price 1s. 6d.)

It contains the Presidential Address: "THE EVIDENCE FOR THE EXISTENCE OF MAN IN THE TERTIARY PERIOD." By E. T. Newton, F.R.S., F.Z.S., F.G.S.; the ANNUAL REPORT for the Year 1896; and "THE FORAMINIFERA OF THE THANET BEDS OF PEGWELL BAY." With notes on other Microscopic Organisms (*Concluded*). **By Henry W. Burrows, A.R.I.B.A., and Richard Holland. Illustrated by Plates I.–V.**

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

Botany and Marine Zoology.

SPECIALITIES.

LANTERN SLIDES for lectures and demonstrations at 9/- per doz.; on Hire at 2/- per doz. Many photos from Nature—20 extensive sets now complete. The sets illustrative of *Evolution* (200 slides), *Mimicry* (40 slides), *Pond-Life* (56 slides), *Anemones and Coral Reefs* (50 slides), *Fertilization of Flowers* (60 slides), *Plant Histology* (Photomicrographs) are especially fine, and, in certain respects, unique.

MICROSCOPICAL SLIDES, in Botany and Marine Zoology, specially prepared for teaching purposes—quality guaranteed perfect. Price from 5/- per doz. *Plankton mounts and sections of flower- and leaf-buds are specialities.*

3. 500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes. *Special attention is given to the preparation and supply of Scyllium*—perfect quality, 8/- per doz.

4. Disarticulated **OSTEOLOGICAL PREPARATIONS,** mounted on *polished* mahogany or ebonite boards, special processes, &c., distinctively marked, with index. The following are merely representative examples:—Wing of Bird, 6/- to 7/-; Limb of Dog, 7/-; of Rabbit, 5/6; of Dolphin, 10/6; of Monkey, 7/6 to 10/6. **SPECIAL**:—Complete Disarticulated Skeleton of **FROG,** fully indexed, 10/6—very fine preparation. Also Articulated Skeleton of *Scyllium*, in tall museum jar, 25/- complete.

CATALOGUES FREE ON APPLICATION.

JAS. HORNELL, Biological Station, JERSEY.

MOUNTED MODEL SKELETON OF

DINORNIS MAXIMUS (Owen)

(COLOURED AFTER NATURE).

The Model is made from casts of bones figured in Owen's "Extinct Wingless Birds of New Zealand," and on its Pedestal is over 11 feet in height (340 cm.).

Price - - - £75

Address—ROBERT F. DAMON, WEYMOUTH, ENGLAND.

PHOTOGRAPHS OF THE ABOVE ON APPLICATION.

Page & Pratt, Ltd.,

HAVING PURCHASED THE BUSINESS OF

RAIT, HENDERSON & CO., LIMITED,

Printers and Publishers,

Are prepared to undertake the Printing and Publishing of any . . .

MAGAZINES, BOOKS, AND JOURNALS

. . . required to be produced in the best style.

ESTIMATES ON APPLICATION

22 St. Andrew St., Holborn Circus, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY PAGE & PRATT, LIMITED, SUCCESSORS TO RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

MENS
urposes.
ion and
doz.
REPA-
gany or
inctively
merely
/- to 7/-;
in, 10/6;
Complete
indexed,
ticulated
25/- com-

m)

ngless
cm.).

ID.

d.,

t style.

E.C.

ESSORS
C.